Gender, Lithics, and Perishable Technology: Searching for Evidence of Split-Cane Technology in the Archaeological Record at the Mussel Beach Site (40MI70)

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Abstract:

Perishable artifacts made from plants and fibers were likely an integral part of daily life in the prehistoric Southeast. While these items rarely survive in the archaeological record, their manufacture may be identified through the examination of non-perishable tools, specifically lithic artifacts. Observations by ethnographers, travelers, and missionaries in the Southeast have cross-culturally identified women as the primary harvesters and collectors of plant materials for both subsistence and material culture production. While most accounts leave out specific details regarding the tools utilized in production of perishable objects, there is reason to suspect that lithic artifacts were used in various plant processing activities. Unfortunately there has been minimal experimentation with stone tools and native Southeastern plants, and few studies which attempt to link such activities to gendered individuals in the past. This dissertation focuses primarily on the processing of river cane for the production of split-cane technology and attempts to understand how production related activities manifest in the archaeological record.

By combining an Organization of Technology Approach with an Anthropology of Technology perspective, I examine the Archaic and Woodland flake tool assemblage at the Mussel Beach site in Tennessee and attempt to understand, through changes in tool form and function, how gender and population demographics changed during each temporal occupation. As a means of inferring tool type and function, flake tools were examined and characterized by morphological and technological characteristics. In order to infer tool function, lithic artifacts from the Mussel Beach site were examined using both low and high-power microscopy. When the results of the functional analysis are combined with the data from the faunal and paleobotanical assemblages, it is possible to discuss site activities at Mussel Beach from a gendered perspective, and moreover recognize split-cane production in the archaeological record.

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Chapter 1: Introduction

Gender is considered to be one of the most universal forms of social organization. Sexual divisions of labor, including activities related to the harvesting and processing of food, the manufacture and use of different classes of technology, and the spatial locations in which economic and domestic tasks are performed are related directly to an individual's social and cultural identity (Rodning and Eastman 2001). Ethnographic and historic accounts among Native people throughout North America demonstrate that men and women not only specialized in the production of various forms of material culture, but they also possessed specialized gender-based knowledge and skills that often resulted in segregated labor systems. In such systems men and women were known to carry out tasks in spatially distinct settings. Gender roles are known to influence the way in which individuals interact with their environment and, perhaps more importantly, affect choices that are made regarding social, economic, and technological strategies. All forms of material culture, and the processes and spaces associated with their manufacture, are media through which gender roles were enacted. It is, after all, through the study of material culture, more specifically variability in material culture that we may begin to understand the ways in which social dynamics affect technological pursuits at the micro-scale.

This dissertation represents an attempt to understand and recognize, through patterning in material culture, gendered activities and divisions of labor in the archaeological record at the Mussel Beach site (40MI70). The Mussel Beach site (40MI70), located in Marion County, Tennessee, was occupied by groups of hunter-gatherers throughout the Late Archaic and Woodland periods. The site was occupied from roughly 5,480 B.P. to 910 B.P., during various seasons and in different capacities. In the Southeast, the end of Archaic period and subsequent Woodland periods are a time of significant cultural and technological change. It is during this time that plant cultivation intensifies, new crafts and technologies are introduced, there is an increase in population, and hunter-gatherers decrease seasonal mobility and begin to establish long-term settlement patterns (Anderson and Sassaman 2012). Many of these important cultural and economic changes appear to manifest in the archaeological record at the Mussel Beach site and may have facilitated, or perhaps necessitated, changes in social organization and labor. These changes might also have led to an increase in the differentiation between men and women's activities and changes in their social and economic contributions within their respective societies. Such marked changes in material culture, settlement strategies, and subsistence activities, make Mussel Beach an ideal site to study technology from a social perspective. I focus primarily on the lithic assemblage from Mussel Beach, but incorporate information from the paleobotanical and faunal assemblages to determine production-related activities during each temporal occupation.

Throughout this dissertation I rely heavily on ethnographic and historic accounts to infer gendered activities and further establish relationships between plant-based material culture and lithic technology. I investigate the function of expedient flake tools, and attempt to demonstrate that some of the flake tools recovered from the Mussel Beach site were utilized in the processing of plant materials for the production of perishable artifacts. While I focus almost exclusively on split-cane technology, I also consider the roles that other plant materials may have served in the production of perishable material culture at Mussel Beach. Lastly, I utilize the knowledge and skills of contemporary indigenous weavers from the Cherokee Nation to demonstrate the efficiency of flake tools in the processing and manipulation of river cane for basketry, and to document the outcome of wear from specific use-related contexts. The implements used during these ethnoarchaeological experiments serve as part of a comparative collection and are used to help identify plant processing activities at Mussel Beach.

The research and results presented in this dissertation are significant because there is a gap in archaeological knowledge regarding the processing and manipulation of plants materials for the production of plant-based material culture. While this has been largely the result of archaeological preservation, I would argue that it is fundamentally driven by androcentric biases which “elevate the roles of men” (Stone 2011:4) and attribute most forms of lithic technology to hunting-related tasks. The recognition of signatures of certain plant processing activities on lithic artifacts will make perishable artifacts more visible archaeologically, and more importantly, it offers a means to engender lithic technology within specific archaeological contexts. While it may be beyond this dissertation to attribute gender specifically to individual artifacts, I focus on tool use and contexts of production in an attempt to better understand how gendered individuals make, use, and discard material culture.

As noted, archaeological investigations at the Mussel Beach site document changes in site use over time from a series of temporary logistical camps during the Late Archaic, to longer more intensive occupations during the Middle Woodland. Discernable changes in subsistence activities and resources procurement strategies between each temporal component are also evident throughout the site’s occupation. Subsistence evidence from the Late Archaic occupations suggest a reliance on hunting and gathering; while during the Middle Woodland period there is a greater reliance on shellfish and cultivated plants. Ethnographic accounts among historic and contemporary shellfishing societies, document women as the primary collectors and processors of shellfish (May 1982; Meehan1975; Murdock and Provost 1973; Waselkov 1987). In many cases, shellfish collection takes place away from the home base at temporary camps that are frequented by dozens of women and children at different times throughout the year (Meehan 1975; Moss 1993). In addition to shellfish collection, women are often observed engaged in other activities including the gathering of plant materials for subsistence or economic purposes and the harvesting of mast resources for future consumption (Claassen 1991). This shift in the dietary importance of shellfish and plant foods strongly suggests that population demographics fluctuated between the Late Archaic and Woodland occupations at Mussel Beach, with perhaps more women and children present during the later time periods. By documenting changes in tool function and site activities, as determined by changes in material culture and their distribution on the landscape, it may be possible to identify different social and material contexts of artifact production (Dobres 1995:34).

When investigating the lifeways of prehistoric hunter-gatherers, archaeologists in the past have had a tendency toward a dichotomous view of the division of labor (i.e. man the hunter/woman the gatherer) and have imposed this dichotomy on material culture. Men were often cited as producing tools of hard materials, like stone, bone, antler, and ivory, while women were associated with the manufacturing of perishable objects from soft materials, including plant fibers and animal skins (Brumbach and Jarvenpa 2006:176). Perishable material culture, by definition, denotes a class of artifacts that do not ordinarily preserve in the archaeological record. In the absence of direct evidence, or depositional contexts favorable for their preservation, perishable objects, and the individuals who made them, receive minimal archaeological attention.

Baskets, matting, cordage, and fabrics manufactured from plant materials represent forms of technology and material culture traditionally associated with female production and labor. With few exceptions, Native American women have been identified as the primary basket makers within their respective communities. While men have been observed participating in aspects of basket production, including the harvesting and processing of plant and fiber materials, these tend to be in circumstances where baskets have become vital economic resources. When baskets become a commodity and an important trade good, production within many Native communities tended to shifted from women to men, or became an activity in which all members of the community participated (see Chapter 3). However, the majority of early accounts from ethnographers, explorers, and missionaries emphasize the centrality of plants and plant-based technologies within an indigenous women's world (Adair 1775; Axtell 1981; Bartram 1776; Hudson 1976; Swanton 1946). To assume that women were preferentially producing perishable objects is not problematic given the extensive ethnographic and historic accounts attesting to these relationships. What is problematic however, is the failure to fully explore the various processes associated with the manufacture of perishable artifacts and the ways in which women used particular tools to harvest and process the raw materials essential to their craft. Unfortunately, there is limited knowledge regarding the prehistoric manufacture of many plant-based technologies.

Within the context of the Late Archaic and Woodland periods in the Southeast, roots, stems, tubers, and even leaves of hundreds of different plants would have been harvested and processed using technology available in the natural environment. While some plants can be used in their natural state, many require some manner of processing to ensure that they are flexible or soft enough to manipulate. Minimal processing might include the soaking or boiling of plant materials, but in many cases it is necessary to remove unwanted vegetal components, including leaves, branches, or fibers. Within prehistoric contexts, processing would have been done mechanically, by hand or with the aid of a sharp instrument, by stripping, scraping, or shredding until the objective material is in its desired state (Norton 1990). There is little doubt that many of the activities associated with the processing of plant materials would have been accomplished using a variety of tools, of which lithic artifacts would have been essential. References to plant-harvesting technologies among Indigenous people in the Northwest Coast, California, and the Southeast reference the use of stone knives or simple flakes prior to the introduction of European technology (Anderson 2005; Colvin 2006; Hill 1997). Unfortunately, evidence for the manipulation of plant materials into artifacts, and the artifacts themselves, are poorly understood in the archaeological record of the Southeast where there is limited preservation of perishable artifacts. This large gap in knowledge may also be explained, to some extent, by a failure to explore relationships between stone tools and plants explicitly for the manufacture of plant-based technologies.

Stone tools represent one of the few forms of recovered material culture to readily preserve in the archaeological record. Depending upon geographic and temporal contexts, lithic materials are likely to encompass a large percentage of the total cultural assemblage, and thus hypotheses regarding past human behavior have relied extensively on the analysis of lithic technology. Most lithic assemblages consist of an array of formal lithic artifacts, including bifaces, projectile points, and unifacial tools, as well as the byproducts of manufacturing processes, or debitage. Debitage assemblages can consists of thousands of individual flakes, flake fragments, and pieces of lithic shatter of varying sizes and shapes. Flakes are essentially the simplest kind of stone tool, as they can be utilized with little to no retouch or modification. They are produced during core reduction either as the incidental by-product of tool manufacture, or intentionally to be used for a specific task (Holdaway and Douglas 2012). When utilized in the locus of origin, with little or no modification, and then subsequently discarded in that same location, flake implements are often described as being expedient in nature (see Chapter 2 for discussion of expedient/curated technologies).

It has been suggested that many expedient tools fall within the female domain of tool production and use (Gero 1991; Owen 2000; Finlay 2013), although this theory has remained largely untested (see Gero 1991). This does not imply, however, that all expedient tools were used exclusively by women, nor does it imply that expedient flake tools encompassed the totality of lithic use among women. Observations among the Konso, a hunting and gathering society in Ethiopia, demonstrate that women actively produced bifacially retouched scrapers for the purpose of processing hides (Weedman 2008; 2010). The harvesting and processing of certain raw materials, including plants, may have required large unifacial and bifacial implements, however non-retouched flakes are shown to have been extremely efficient tools that can be used for a considerable length of time to accomplish specific tasks. Of all lithic tool types, non-retouched flakes and blades exhibit the sharpest, most efficient cutting edges. These are tools that can be produced rapidly, and while often serving multiple functions, it is unlikely that energy is wasted on retouching or repurposing flake tools when a new implement can easily be obtained from debitage assemblages or struck from an existing core.

Unfortunately most debitage assemblages are analyzed using aggregate techniques, which do not include the analysis of each individual flake specimen. Aggregate analyses use mass processing techniques to characterize assemblages based on production stages and reduction strategies (Andrefsky 2005; Carr and Bradbury 2004). Oftentimes a small sample of debitage is selected for individual attribute analysis, but by not examining all individual specimens within an assemblage many flake tools can be overlooked or go unexamined. The initial analysis of the Mussel Beach lithic assemblage by New South Associates, for example, only included the examination of a 23% (n=6,523) sample of the total debitage assemblage. As a result, the remaining assemblage of debitage was left unexamined (n=21,609) and a large proportion of the lithic tool assemblage unaccounted for. The results of the debitage analysis were used by New South Associates primarily to infer reduction strategies, and none of the identified tools were subject to usewear analysis prior to this study.

Sassaman (1992:76) has argued that even though flake tools comprise significant portions of most lithic assemblages, they are not specific enough with respect to function, place, and the sexual division of labor, to be useful in testing ideas about gender relations. The examination of flake tools from Mussel Beach will test this assumption. The usewear analysis of the flake implements will result in functional interpretations of this class of technology with regards to use-action and materials worked. The integration of functional interpretations with morphological and technological data should reveal information related specifically to functional criteria or specific morphological characteristics which were desirable in terms of flake selection for the completion of specific tasks. By incorporating available spatial data and analogies discerned from ethnographic studies, I aim to explore and understand how, and in which ways, gender manifests in the production of material culture at Mussel Beach.

In this dissertation I will attempt to elucidate gendered activities, spaces, and technology over time at the Mussel Beach site. I rely heavily on ethnographic and historic accounts to establish relationships between women, plant-based material culture, lithic technology, and shellfishing activities. I challenge the notion that analyses of lithic technology must be free of gendered interpretations and hypothesize that many simple flake tools were used to process plant materials, like river cane, for non-subsistence purposes. Assumptions regarding river cane processing at the Mussel Beach site are based primarily on the presence and condition of carbonized samples of cane and the presence of carbonized river cane seeds. In order to test the hypothesis that river cane was processed at Mussel Beach I examine flake tools for evidence of microwear. This study utilizes lithic assemblages from each of the five temporal components identified at the Mussel Beach site, and uses the results of both low and high-power microscopy to determine tool function. The existing analyses of the faunal and paleobotanical assemblages are incorporated to not only support functional interpretations, but also to identify spatial locations in which activities took place.

An experimental tool collection was also created using both the same, and similar raw materials to those recovered at the Mussel Beach site. In order to identify cane processing on lithic tools and observe the physical byproducts of this process, I was fortunate enough to collaborate with craft specialists and basket makers in the Cherokee Nation. The experimental tools that resulted from this collaboration not only provided a comparative collection, but demonstrated the effectiveness of expedient flake tool technology in the processing of cane for split-cane baskets. The byproducts of cane processing were also compared to the carbonized cane from Mussel Beach. With this approach, I was able to replicate realistic use contexts, wherein the individuals using the tools were performing tasks in which they were highly skilled and experienced. Experimental tools used by experts are more likely to develop authentic traces of use that can be examined for microwear (Bamforth 2010; Stone 2014).

In addition to lithic artifacts, this dissertation also examines a sample of shell implements recovered from within several midden contexts at the Mussel Beach site. Because of the widespread cultural association of women with shellfishing activities, it is hypothesized that the shell tools recovered from Mussel Beach were manufactured and used by women during shellfish processing events. To test this hypothesis I examined the shell tool assemblage and attempted replication experiments in an effort to determine if the shell implements were culturally modified or produced through some other natural taphonomic or post-depositional processes. I next attempt to characterize shell tools based on shared morphological characteristics and create a working typology. Finally, I attempt to examine samples of the shell tools under low and high power magnification in an attempt to quantify wear patterns visible on the working edges. Interpretations regarding shell tool use and technological organization will be based on ethnographic analogy, contexts of production, and if possible the results of the morphological and functional analyses.

The dissertation will be structured as follows to address the issues raised in these introductory remarks. In Chapter 2 I discuss the primary theoretical frameworks structuring this project. The research and interpretations presented in this dissertation draw heavily from an "Anthropology of Technology" approach. This theoretical paradigm attempts to embody cultural meaning into technological artifacts as a means to understand technological variability and addresses ways in which technology influences, and is influenced by, social and cultural processes (Dobres 1995; Ingold 1997; Lemonnier 1984; Pfaffenberger 1992).   I use this theoretical approach to generate hypotheses regarding the organization of technology and technological variability at the Mussel Beach site and to address more specifically the ways in which gender influenced technological strategies during each temporal occupation.

In Chapter 3 I provide a brief history of gender studies in archaeology and examine ethnographic and historic accounts of women making and using both stone tools and perishable material culture. Documentary evidence for women using stone tools is rare in North America, but it is well documented in Australia, Ethiopia, and other parts of the world. In this chapter I will also discuss women's association with plant and fiber-based technologies. Because of the importance of river cane among Southeastern Indians, I will also focus heavily on the ethnographic accounts of cane use among several Southeastern tribes and archaeological evidence for cane use in this region. I also provide information about cane processing obtained during the experimental portion of this project.

In Chapter 4 I provide a comprehensive site background of the Mussel Beach site. This will include details regarding previous excavations as well as the results of the most recent excavation conducted by New South Associates between 2009 and 2010. The chapter will include information about the individual archaeological assemblages, including the ceramics, paleobotanical, and zooarchaeological remains, and lithics. I will provide detailed information about the analyses conducted on each assemblage and the results of those analyses as presented in the Mussel Beach site report. Lastly, I will include a section detailing previous site interpretations provided by New South Associates, the results of a recent study of the Mussel Beach paleobotanical remains conducted by Stephen Carmody (2014), as well as the results of my own examination of 23 river cane samples recovered from the Mussel Beach site.

In Chapter 5 I detail the methods used to identify additional flake tools within the debitage assemblages at Mussel Beach and describe the criteria used to distinguish utilized, or use-modified flakes, from non-utilized debitage. I provide an overview of the data collection process, providing descriptions of how and why certain attributes were recorded on each individual specimen. Included in this chapter is also a description of the typological classification scheme used to classify flake tools into categories based on wear patterns and morphology. I provide descriptions and summaries of flake tool types based on morphological characteristics, size, weight, degree of edge angle, and raw material type. Lastly, I compare the flake tool assemblages from each temporal component looking for patterns and changes in flake tool use over time. This chapter also includes preliminary functional information derived from the low-power microscopic analysis.

In Chapter 6 I present a historical overview of high-power microscopic analysis and discuss the various methods and analytical techniques used to determine the function of stone tools. I also provide descriptions and characterization of microwear evidence and discuss how the use and implementation of experimental programs help archaeologists derive functional interpretations of prehistoric tools. This chapter also includes descriptions of the methods used to analyze and quantify the wear patterns observed on the experimental and archaeological specimens. The results of the usewear analysis are also presented in this chapter. I conclude this chapter with a discussion of the general trends in flake tool use over time at Mussel Beach, and present information related to changes in tool function.

In Chapter 7 I pull together all of the information presented in previous chapters to discuss the possible evidence for gender activities, spaces, and technology at the Mussel Beach Site. I use the information gathered from ethnographic analogies, the experimental cane processing, and microwear analyses to discuss how changes in tool function might reflect shifts in site use and resource exploitation by gendered individuals.

My conclusions will be presented in Chapter 8, and these will be based on the discussion provided in Chapter 7 as well as information presented through this dissertation. I will also include a discussion on directions for future research.

Chapter 2: Theoretical Foundations

It has been more than two decades since Joan Gero (1991) challenged the assumption that males were wholly responsible for producing all forms of lithic technology recovered in prehistoric archaeological contexts. In her pivotal and groundbreaking work, Gero (1991:164) introduced a theoretical perspective that recognized gender as "a dynamic and critical construct in social life," one that provided a "framework for reconstructing gender relations as they are mediated through material culture" (1991:164). By examining lithic assemblages at the microscale, and taking into account variability in raw material, degree of tool preparation, and the specific contexts of tool manufacture and use, Gero created a series of testable hypotheses through which she was able to insert women as active participants in lithic technological pursuits. It was, by all accounts, one of the few early studies to critique the androcentric biases which permeated not only methodological approaches to stone tools, but also interpretative frameworks (also see Ardener 1975; Conkey and Spector 1984; Dahlberg 1981; Slocum 1975).

Gero's "*Genderlithics"* sought to not only engender stone tools, but to essentially re-gender lithic technology with a theoretical approach that recognized all forms of technology as being socially and culturally mediated and produced by gendered individuals (Gero 1991). Despite the significance of this approach, and Gero's continued contributions to feminist scholarship in archaeology (Conkey and Gero 1991; Gero 1993; Gero and Conkey 1997; Gero 2001; Gero and Scattolin 2002), there have been limited attempts to fully incorporate gender as an analytical tool to understand the variability present within stone tool assemblages (see Bird 1999; Brandt et al. 1996; Close 2006; Finlay 1997; Frink and Weedman 2005; Owen 1994; Weedman 2010). The contexts in which men and women produced and used stone tools would have been socially, culturally, and temporally contingent, and the materials processed and produced as a result, dependent upon the individual's role within their respective communities. It is well documented among hunter-gatherers throughout the world that men produced and used stone technology to complete a variety of tasks, of which the most commonly cited are hunting related activities. The processing of plant materials with lithic technology, although documented in North America, is not often attributed to women, despite a rich ethnographic record demonstrating women's association with plants for both subsistence and domestic purposes.

To fully understand the role that stone tools played within any society, and moreover the different ways in which tools would have been used by gendered individuals, it is necessary to first consider the types of tasks in which a single instrument might have been employed, as these tasks are directly indicative of people's interactions with artifacts and their environment. In this light, the artifacts themselves are viewed as representing one aspect of the technological system, the other aspect is the manufacturing process, as this considers how one form of technology is utilized to produce another.

Secondly, it is necessary to utilize a theoretical approach that is not only applicable at any analytical scale, but one that understands that the use and production of technology involves the active and deliberate manipulation of raw materials by individuals participating in a dynamic cultural system. As a theoretical framework, an "Anthropology of Technology" approach integrates technological, material, and social dimensions of material culture production (Dobres 1995) to explain variability in technology, technological organization, and changes in activities at various organizational, temporal, and spatial scales. Gender, as a social dimension, affects the production of material culture because, "identities, practices and ideologies are inscribed onto the everyday world of material resources and power through the knowledge, skill, production of, access to and use of material culture" (Dobres 1995:28). There is an inherent understanding that technology is not only integrated into every aspect of the cultural system, but that it pervades and is embedded in *all* human activities (Pfaffenberger 2001).

In the next section I address the specific research questions on which this dissertation is focused and provide a brief summary of the regional prehistory for the Archaic through the Woodland periods in the Southeast and greater Eastern Woodlands. This summary is intended to put into context how changes in such things as subsistence practices and settlement strategies would have transformed the cultural landscape at Mussel Beach and affected the organization of labor and technology. Because this dissertation seeks to not only understand changes in technological and functional aspects of flake tools, but also the social dimensions associated with their use, I next outline technological organization, as this theoretical and methodological approach will be used as a framework for integrating both the technological and social aspects of technology at Mussel Beach.

Adopted originally to explore the use of different technological strategies employed by hunter-gatherers in various social, economic, and environment contexts (Binford 1979), technological organization has been adapted to include several behavioral variables which affect technological choices at the macro and microscales. Factors affecting technological organization, and technological strategies in general, include environmental conditions, cultural systems, economic and social strategies (Binford 1979; Nelson 1991) and more recently population demographics (Carr et al. 2012; McCall 2012). Throughout this section, I attempt to contextualize the way in which gender theory is used to inform technological organization. I conclude this chapter with a brief history of gender studies in North American archaeology.

2.1 Research Questions

In order to investigate the full range of activities taking place at the Mussel Beach site, and make inferences regarding the social dimensions of these activities, this dissertation investigates first the flake tool assemblages from each temporal occupation. The flake tools comprise non-retouched utilized flakes, minimally retouched flakes, and flakes with extensive retouch. Before being analyzed for microwear, the flakes were examined and several technological and morphological attributes recorded. The identified tools will be compared to specimens concluded to be non-tool debitage to reveal potential patterns in the morphological characteristics desirable for flake tools, and also characteristics desirable on tools intended for specific tasks. Secondly, the spatial distribution of the flake tools will be assessed and combined with data from the paleobotanical and faunal assemblages to understand the allocation of space during each phase of occupation as it relates to specific activities. As Bradbury and Creasman (2008) state, "The organization of space can be viewed on two levels: how people position themselves in relationship to others and how space is allocated or used within activity areas. The former reflects social constraints or norms while the latter may be conditioned by function and gender" (2008:33). The results of these studies will be presented in Chapters 5, 6, and 7.

This dissertation, and the interpretations presented, is built upon a set of four propositions: 1) *the functions of utilized and minimally retouched flake tools change throughout each temporal occupation at the Mussel Beach Site with a significant increase in plant processing activities during the latter Woodland components;* 2.) *flake implements with evidence of plant wear were used primarily in the processing of plants for the production of perishable material culture, including, but not limited to, split-cane baskets and mats;* 3.) *plant-processing during the Middle Woodland occupation was accomplished by individuals associated with the* *collection and preparation of shellfish, and may further have been conducted using expedient lithic and shell tool technology;* and finally 4.) *increases in plant-processing activities for perishable material culture during the Middle Woodland demonstrates changes in population demographics and the visibility of women's work.* Gender is essentially a culturally defined status that is considered to be an abstract concept. It is, at its core, a set of values, beliefs, and expectations that define notions of femininity and masculinity, and emphasize appropriate behavior, divisions of labor, and associations with certain forms of material culture (Arnold 2006; Eastman 2001; Hays-Gilpin 2003; Hill 1998; Stig-Sorenson 2001). To some, gender is understood best as a process that is malleable throughout an individual's lifetime (Eastman and Rodning 2001). To others, gender is intrinsically linked to biologic sex, however there is an understanding that gender roles and associated or prescribed responsibilities may change during different stages of an individual's physical and emotional development (Eastman 2001). Gender role and relations consider more broadly social interactions between men and women, specifically the differential participation of men, women, and children in activities within their communities. The study of gender roles emphasizes the material side of gendered lives (Nelson 2002), as there is a recognition that the enactment of gender arrangements often have observable material and behavioral correlates (Hays-Gilpin 2003).

Rather than focusing explicitly on finding women in the archaeological record, this dissertation attempts to explore the ways in which certain forms of material culture reveal a range of production activities performed by individuals who differentiated tasks according to gender/biological sex. Identifying contexts in which gender would have played a role in the production and use of material culture makes it possible to explore gender without being dependent entirely on gender identification. I focus on processes associated with the production of split-cane technology, and other forms of plant-based material culture, because these were once tightly woven into the lives of prehistoric foragers throughout the Southeast, and were documented as being culturally significant and highly gendered at contact. When a technology is incorporated into every aspect of life-- domestic, economic, social, and political, as river cane once was-- preservation should not erase *all* traces of its production or use from the landscape. This is particularly true when the manufacturing process can only be accomplished with the aid of non-perishable technologies, like stone tools.

As will be discussed, several important sociocultural, economic, and technological changes occurred in the Southeast between the Late Archaic and Woodland periods. One of the most significant changes, which is reflected in the archaeology at Mussel Beach, is the substantial increase in the reliance on both cultivated plant foods and freshwater mollusks. Understanding the ways in which this significant shift in subsistence would have affected technological strategies requires additional questions and predictions regarding the organization of both technology and labor during the transition from forager to farmer in Southeast.

2.2 The Archaic and Woodland Periods in the Southeast

In the next section I provide an overview of the prehistory of the Archaic and Woodland periods in the Southeast. Current understandings of Southeastern prehistory are based on extensive archaeological investigations and the analysis of lithic, ceramic, paleobotanical, and faunal remains.

2.2.1 The Archaic Period (11,500 – 3,200 cal. yr. B.P.)

In Eastern North America, the Archaic period represents the longest cultural tradition, spanning nearly 8,300 calendar years (Sassaman 2010). The Archaic period is often characterized by the dramatic cultural changes which occur throughout the interval, changes which included the development of large-scale interaction networks, the construction of monumental architecture, the development of more complex forms of social organization, and shifts in settlement and mobility strategies associated with the intensification of foraging activities (Anderson and Sassaman 1996; 2004). The Archaic period has been divided into three subperiods: Early (11,500–8900 cal yr B.P.), Middle (8900–8500 cal yr B.P.) and Late (5800–3200 cal yr B.P.), with changes in technology and subsistence being used to differentiate between them. Archaeological evidence suggests that climatic and environmental changes were partially responsible for many of the social, technological, and demographic changes observed throughout the Archaic period. While changes in projectile point style help to define the changes during the Archaic, several other technological innovations occur throughout this interval as well. These include the development of stone and ceramic vessels, improvements in ground stone technology, and ornaments and tools manufactured from freshwater and marine shells (Bense 1994:62). As significant as many of the developments were, they did not occur at the same time or with the same intensity throughout the region, and thus this tripartite division is not considered to be universal across the Southeast (Anderson and Sassaman 2012:66).

2.2.2 Early Archaic (11,500–8900 cal yr B.P.)

The onset of the Early Archaic period coincides roughly with increases in global temperature that mark the end of Pleistocene and Younger Dryas and the beginning of the Holocene era (Anderson and Sassaman 2012:71). This major climatic shift in the Southeast resulted in the expansion of oak and hickory forests and the replacement of Late Pleistocene flora and fauna with modern species (Anderson and Sassaman 2012). Populations during this early interval appear quite dense on the landscape as indicated by the considerable increase in sites from the preceding Paleoindian period (Anderson and Sassaman 2012:71). Archaeological assemblages associated with the Early Archaic demonstrate a shift from lanceolate projectile points, to side- and corner-notched and bifurcate hafted bifaces (Anderson et al. 1996; Anderson and Sassaman 2012; Bense 1994; Chapman 1985:147–149). Common projectile point types recovered from Early Archaic sites in the region include Kirk types, Palmer, LeCroy, and Big Sandy among others (Chapman 1985), and these smaller projectile points demonstrate a reliance on smaller game animals, including white-tailed deer. The choice of raw material for lithic artifacts also demonstrates an increasing reliance on locally available resources, which indicates respectively, a decrease in group range (Anderson and Sassaman 2012:72; Anderson 1990:198–201, 1996:160–163) and the beginnings of people settling in on the landscape close to important or valuable raw materials (Daniel 1998). Many of the changes in technology and mobility are also thought to represent a shift in settlement strategies from logistical mobility to more of a collector-based strategy (Anderson and Sassaman 2004).

2.2.3 Middle Archaic (8900–8500 cal yr B.P.)

Just as the onset of the Early Archaic period coincides with an abrupt climatic event, the beginning of the Middle Archaic period corresponds with the Mid-Holocene climatic interval, also known as the Hypsithermal (Anderson and Sassaman 2012:73). This event is characterized by an increase in temperature and a decrease in precipitation in the Southeast, and it is suggested that the seasonal temperatures were significantly hotter and dryer than the modern climate in the region (Anderson and Sassaman 2012:73). In response to the warmer and dryer conditions that ensued during the Middle Archaic, flora and fauna communities expanded and contracted, creating more and less favorable habitats for human exploitation and occupation. In the Midwest and Midsouth, floodplains and river channels became increasingly more stable and productive habitats as the result of decreasing rainfall. The backwater slough habitats and resulting shoal environments were favorable for freshwater shellfish as well as a suite of other flora and fauna (Anderson and Sassaman 2012:73). The productivity of riverine environments likely made these locations much more attractive, and the intensification of shellfish exploitation throughout this region signifies a new reliance on shellfish as a subsistence staple.

The Middle Archaic period is traditionally recognized by projectile point types. Over much of the Southeast the notched and bifurcate tools are replaced by projectiles with squared and contracted stems, some of which include Kirk Stemmed, Stanly Stemmed, Morrow Mountain, Ledbetter, and Benton (Coe 1964; Chapman 1985; Anderson and Sassaman 2004). Ground and polished stone artifacts , including plummets, celts, atlatl weights, and grooved axes increase in frequency, as do nutting stones, mortars, and pestles, which reflect an increase the reliance on mast resources (Anderson and Sassaman 2004:100). Although preservation conditions in this region can be poor, there is evidence for the use of wood, bone, and antler tools, and also some evidence for the use of shell as raw material for tool production. Subsistence economies associated with the Middle Archaic were based primarily on the exploitation of seasonally available resources, including wild plants and animals, as well as a variety of coastal and marine resources.

The Middle Archaic period is also characterized as a time of immense cultural change and increasing social and cultural complexity. The first monumental architecture appears at a number of locations in the Lower Mississippi valley between 4275 and 3750 B.C.. Both earthen and shell mounds were constructed throughout the Southeast, and evidence would suggest that their construction and use reflected not only new forms of social organization, but the emergence of collective ceremonial activities and shared belief systems (Anderson 2002; Anderson and Sassaman 2004; Claassen 1996; Thompson 2007). The development of long-distance trade networks increased group interaction on the landscape, helping to solidify group alliances and possibly alleviate subsistence related stress. There is evidence to suggest that populations during the Archaic witnessed increases in violent encounters, as evidenced by high rates of skeletal trauma (Anderson and Sassaman 2004; Anderson et al. 2007; Bense 1994). There is still limited evidence during this time period regarding divisions of labor by gender, however analyses of the skeletal remains of several female skeletons does indicate differential stress in skeletal tissue, suggesting repetitive one-handed tasks, which could perhaps be related to the processing of various plant materials (Bridges 1989; Smith 1986).

2.2.4 Late Archaic (5800–3200 cal yr B.P.)

Modern climatic and environmental conditions were established by the beginning of the Late Archaic period in the Southeast (Anderson and Sassaman 2012:74). Increases in precipitation lead to the development of productive estuarine habitats and an expansion of freshwater wetland habitats in the lower coastal plains and Florida (Sassaman and Anderson 2004). The reliance of freshwater shellfish for subsistence and mounding-related activities intensifies during the Late Archaic, especially along major rivers and their tributaries and within river valleys in Tennessee and Alabama (Sassaman and Anderson 2004). Dense midden and mound accumulations in both riverine and coastal environments demonstrate not only a preference for marine resources during the Late Archaic, but the use of many of these structures as both residential locations and mortuary facilities suggests a ritual and ceremonial significance (Claassen 1991). In addition to an increased reliance on shellfish and other marine resources, Late Archaic populations intensified their exploitation and utilization of wild and cultivated plant foods, as well as a few key domesticates indigenous to the region.

In parts of the Southeast, including Tennessee and Kentucky, there is considerable evidence for the early and widespread consumption of domesticated and cultivated plant foods. The cultivated plants, which do not exhibit permanent morphological or genetic changes but occur in exceedingly large quantities throughout the region, include little barley (*Hordeum pusillum*), maygrass (*Phalaris caroliniana*), and knotweed (*Polygonum sp.*). The domesticated plants, which underwent morphological and genetic changes as the result of human intervention and experimentation, include goosefoot (*Chenopodium berlandieri* ssp. *jonesianum*), sunflower (*Helianthus annuus*), sumpweed (*Iva annua*), and pepo gourds (*Cucurbita pepa*) (Gremillion 2004; Smith and Yarnell 2009:6562). While these plants were grown and harvested on a relatively large scale, Late Archaic populations continued to rely heavily on local mast resources, including hickory and acorn. Ceramic technology, which appears in the middle Tennessee Valley ca. 3,300 B.P. (Sassaman 1993) and about 1000 years earlier in coastal areas to the south and east, likely facilitated the large-scale processing and storage of all plant resources. Many archaeological sites associated with the Late Archaic in central and west Tennessee contain large cylindrical storage features described as "silos" (Faulker and McCollough 1982:92). Some of the features were believed to have served as storage facilities for large numbers of nuts (Sassaman 2010:141–142) and the presence of processing technology including nutting stones, mortars, pestles, and anvils suggests on-site processing.

Land use and settlement patterns from productive floodplain and coastal sites indicate a higher degree of sedentism during the Late Archaic, with some coastal locations being occupied nearly year round (Anderson and Sassaman 2012; Russo 1996; Thompson and Turck 2010). There is also an increase in the utilization and occupation of cave and rockshelter locations (Simek et al. 1998). Mounding activities and the construction of monumental landscapes also intensifies considerably in the Late Archaic and is best exemplified after 3700 cal yr B.P. at the Poverty Point site in northern Louisiana (Kidder 2011; Kidder et al. 2009). Projectile points are used as temporal indicators, although some Late Archaic projectile point types are known to overlap with some earlier Middle Archaic traditions. Common Late Archaic projectile points recovered in east Tennessee include Ledbetter, Cotaco Creek, Iddins, Savannah River, Wade, and McIntire (Bentz 1995:142; Chapman 1977; Lewis and Kneberg 1959; Faulkner). Ceramic vessels are also used to identify Late Archaic sites in many parts of the Southeast after ca. 5000 cal. yr B.P. and changes in such things as temper and surface treatment suggest differentiation in cultural identity on the landscape.

Throughout the Archaic period populations were steadily increasing on the landscape and populations were adapting to climatic and environmental fluctuations. In response to fluctuating environmental conditions and demographic circumscription, Archaic populations began to settle in on the landscape and intensify their use of productive locations and predictable resources. Changes and innovations in technology signify a reorganization of subsistence strategies and perhaps a reorganization of labor associated with horticultural activities. The increased reliance of cultivated and domesticated plant foods and foraged mast resources may have led to segregated labor systems and new roles for women as they used their knowledge of local environments and natural resources to influence settlement patterns and new land-managment strategies.

2.2.5 The Woodland Period (3,200 – 1000 cal yr B.P.)

Many of the cultural and technological characteristics used to define the Woodland period in the Southeast manifest archaeologically in the preceding Archaic period. The Woodland Period (ca. 3200 – 1000 cal yr B.P.), which was once defined by the widespread use of pottery, the construction of monumental architecture, and development of garden economies (Anderson and Mainfort 2002; Sassaman and Anderson 2004:111), is now recognized by the intensification of these practices and also by the development of regionally distinct cultural traditions across much of the region (Anderson and Sassaman 2012:113). The Woodland period is divided by many scholars into Early (3200 – 2225 cal yr B.P.), Middle (2225 – 1725 cal yr B.P.), and Late (1725 – 1020 cal yr B.P.) subperiods, although it is recognized that the beginning and end points differ across the Southeast. Throughout the Woodland period vast and elaborate interaction networks connected communities with a shared religious and ceremonial tradition that was characterized by elaborated mortuary customs and the production and trading of material culture produced from non-local raw materials. Ceramic vessels also take on a variety of forms and decorations, which enable archaeologists to define locally distinct traditions (Anderson and Mainfort 2002; Sassaman 2002; Sassaman and Anderson 2004:112). The intensification of plant use and the development and dispersal of agricultural practices also help to define regional differences in the development of food producing economies throughout the Woodland Southeast (Gremillion 2002:483). There is also a general trend in settlement organization towards more permanent, organized communities, with distinct warm and cold-weather occupations and structure types (Faulkner 2002).

*2.2.6 Early Woodland (*3200 – *2225 cal yr B.P.)*

The beginning of the Woodland period is marked by diminished archaeological resolution associated with changes in land-use practices, the dispersal of populations, and the disruption of Archaic social networks (Anderson 2010; Anderson and Sassaman 2012:115; Kidder 2006, 2010). The Early Woodland period is traditionally recognized by the widespread appearance of pottery across the region. By 700 B.C. pottery is prevalent in the Southeast and archaeologists have defined several discrete ceramic traditions based on style and surface treatment. Regionally distinct ceramic styles are presumed to be linked to specific cultural groups or traditions, and archaeologists have used variations in physical attributes and surface treatments to help define, both spatially and temporally, many southeastern Woodland cultures (Sassaman 1993; Bense 1994; Cobb and Nassaney 2002).

Although archaeological visibility is limited during the Early Woodland, generalizations regarding settlement, mobility, and community patterns have been made. In general, Early Woodland populations were small, mobile foragers, dispersed seasonally across the landscape. Settlements in the Middle Tennessee River valley demonstrate the use of short-term or seasonal settlements along major waterways as well as within rockshelters and caves in the adjacent uplands (Anderson and Sassaman 2012;121; Walthall 1980). The use of cave and rockshelter locations during this period have provided additional information regarding Early Woodland subsistence practices, particularly the use and consumption of cultivated and domesticated plants, which increase considerably during this period (Gremillion 1996). Early evidence of food production comes from several caves and rockshelters in eastern Kentucky, including Salts and Mammoth Caves (Gremillion 1995; Yarnell 1969) Hooton Hollow (Gremillion 1996), and Newt Kash (Gremillion 1996). Carbonized plants remains and analyses of paleofecal specimens from these locations demonstrate the ever increasing dietary importance of cultivated and domesticated plant foods and the importance of storage-based economies.

Evidence for social organization during the Early Woodland comes primarily from burials and mortuary facilities, which are quite limited in the Southeast at this time. Across the region many mound structures became receptacles for internments and locations for mortuary-related activities. While there is certainly regional variability associated with the construction and use of mound structures, most burials suggest that Early Woodland populations were essentially egalitarian, lacking any permanent form of social hierarchy (Anderson and Mainfort 2002). The allocation of labor and the contributions of men and women, however, were likely becoming increasingly differentiated, as changes in subsistence and technology increased social demands on men's and women's labor. Sassaman (1991:73) argues that the large-scale adoption of ceramics and intensification of shellfish consumption represents an increase, or an addition to, women's contributions to subsistence production during the Early Woodland. He envisions that as women began to contribute more through subsisence and economic activities, that this may have led to an increase in "decision-making power…with regard to settlement choices, production, schedules, marriages, and conflict resolution, among other things" (Sassaman 1992:73).

*2.2.7 Middle Woodland (*2225 *– 1725 cal yr B.P.)*

Many of the cultural and regional traditions which manifested in the Early Woodland period persist into the Middle Woodland and intensify in many parts of the region. There is an elaboration and spread in mound construction for mortuary purposes and a rise in ceremonial activity, which is believed to be connected to the Hopewell tradition in the Midwest (Bense 1994; Anderson and Sassaman 2012). Most evidence for a connection with Hopewell is the inclusion of Hopewellian-type artifacts in burial contexts. Classic Hopewell artifacts include copper cutouts, panpipes, and earspools, as well as pieces of galena, and mica cutouts (Anderson and Mainfort 2002:10). The inclusion on nonlocal raw materials and ritual-type objects within Middle Woodland burials, of relatively few individuals, suggests a change in social organization, with certain members of the community achieving more wealth and status than others (Mainfort 1988). In southwest Tennessee, the Pinson site exemplifies Middle Woodland social complexity and the elaboration of mound construction, particularly as it relates to ritual, ceremonial, and mortuary behaviors (Mainfort 2013). The greatest concentration of burials in the Southeast also occurs in the middle Tennessee River valley and is associated with the Copena mortuary complex (Walthall 1973). Western Copena traditions are also believed to reflect the emergence of hierarchical societies during the Middle Woodland (Beck 1995).

The presence of Hopewellian artifacts and nonlocal raw materials, and the emergence of major mound centers like Pinson, demonstrates the continued reliance on regional exchange systems throughout the Southeast. This expansive interaction and trade network connected Middle Woodland populations, whose settlement patterns were still quite diverse. Most Woodland habitation sites are interpreted as dispersed hamlets and small villages that were utilized seasonally, but repetitively, over successive generations (Anderson and Sassaman 2012:124). Small domestic sites associated with the McFarland phase in the Duck River Valley of Tennessee, for example, demonstrate a shift towards more distinctive community patterns structured around domestic spaces associated with dwellings and food-processing activities (Faulkner 2002). McFarland sites are characterized as both intensive short term occupations and much more permanent villages as a reliance of cultivated plant foods increases (Crites 1978).

Towards the end of the Middle Woodland period within many parts of the eastern Tennessee Valley, settlements become increasingly more permanent on the landscape. Sites associated with the Owl Hollow Phase (A.D. 200 – A.D. 600) in the upper Duck Valley, for example, contain highly organized settlements with evidence of winter and warm-weather structures (Faulkner 1977, 2002). Many sites contain dense middens, and food-processing locations and technology associated with large storage features, suggesting a growing dependency on garden economies (Crites 1978; Faulkner 2002). Ceramic vessels and projectile point technology continue to be used to differentiate the many cultural traditions that emerged and thrived throughout the Southeast during the Middle Woodland.

2.2.8 Late Woodland (1725 – 1020 cal yr B.P)

The Late Woodland period was once considered to be a time of great cultural decline and disruption throughout the Southeast (Anderson and Sassaman 2012; Anderson and Mainfort 2002; Cobb and Nassaney 2002). Today, it is recognized that during the Late Woodland populations in the Southeast were expanding and adapting to the new pressures and constraints associated with population growth across the region. There is evidence for demographic shifts, increases in warfare and interpersonal violence, and a decline in interregional connections (Anderson and Sassaman 2012; Cobb and Nassaney 2002). The introduction of the bow and arrow (Blitz 1988) and improvement in ceramic technology represent some of the technological innovations associated with the Late Woodland. Mound building, although not ubiquitous across the Southeast, increases in many areas and new mound traditions associated with the emergence of civic-ceremonial centers characterize some Late Woodland sites.

Civic ceremonial centers, such Coles Creek in the lower Mississippi Valley (ca. A.D. 700 to 900), consist of formal mound centers with arrangements of residential and ceremonial structures around open plazas (Kidder 2002, 2004). Elaborate mortuary complexes and assemblages demonstrate a more permanent shift in social hierarchy with hereditary elites and associated kin (Cobb and Nassaney 2002). The presence of flat-topped mounds, site layout, and the complex social and political organization associated with permanent occupation, did lead some scholars to align many Late Woodland sites with Mississippian cultures, referring to them as “Emergent Mississippian” (Anderson and Sassaman 2012:128-129; Fritz and Kidder 1993; Kelly 1983), although this term has fallen into disrepute. The presence of maize was seen as the defining characteristic of “Emergent Mississippian” sites, as maize is not fully adopted by all Late Woodland populations in the Southeast (Cobb and Nassaney 2002). During the early Late Woodland, the introduction of maize does signal the beginnings of a rather dramatic shift in agricultural practices throughout the Southeast. There is an increased emphasis on food production, land-management, and changes in settlement structure in order to accommodate new subsistence pursuits. However, during this period maize appears to have only been consumed in moderate amounts and did not result in the abandonment of a suite of highly productive native cultigens referred to as the Eastern Agricultural Complex (EAC) (Gremillion and Yarnell 1986).

Maize becomes a critical component of later Mississippian societies (Anderson and Sassaman 2012). Mississippian cultures come to be defined not only by the development and intensification of maize agricultural systems, but also by elaborate material culture items, the development of complex religious institutions and associate iconography, the presence of hereditary chiefs and chiefdom level societies, and immense mounds and mound centers arranged around large plazas (Anderson and Sassaman 2012). The Mississippian period is defined by complexity and represents the culmination of cultural developments that began emerging in the Southeast during the Archaic period.

Throughout the Archaic and Woodland periods there are significant changes in material culture, subsistence practices, population demographics, and community and social organization. Fluctuations in climate, environmental conditions, and resources required that populations adapt their social, economic, and technological systems to a variety of new constraints. It is unlikely that gender roles and relationships would have remained static throughout, as they are deeply embedded in historical, sociocultural, ideological, and material contexts (Conkey and Gero 1997). Using material culture to differentiate social identities and connect empirical archaeological evidence to gendered divisions of labor remains a challenge. To fully understand the ways in which material culture is shaped by and responds to various historical processes, it is necessary to establish contexts in which relationships between objects and gender can become visible.

2.3 Organization of Technology

Archaeologists have long been using methods focused on technological organization, a concept originally introduced by Lewis Binford (1979), to understand the variability present in lithic tool assemblages since the early 1980's. This approach, often referred to organization of technology or technological organization, aims to explore the different ways in which technology is produced and manipulated within a variety of ever changing social, cultural, and environmental contexts. Technological organization among hunter-gatherers is often seen as being responsive to a variety of interrelated conditions which affect the ways in which tools are designed, used, maintained, and eventually discarded (Odell 2012). Odell (2012:196) argues that this approach is similar in many ways to behavioral archaeology (refer to Schiffer 1976), in that there is an emphasis on the cultural system and the involvement of social actors in the "creation of their material world" (Dobres 1995).

The process of reconstructing technological organization in the archaeological record is also sometimes associated with the *chaîne opératior* ("operational sequence) approach. As a concept, and analytical tool for studying lithic technology, the *chaîne opératior* approach originated among French archaeologists to describe and understand the relationships between material culture and the individuals using them. The concept is founded on the premise that all forms of material culture undergo some type of cultural transformation during use, and it is possible to study these transformations because the materials or tools being used become extensions of the individuals using them (Leroi-Gourhan 1993). The act of using a tool is understood as being the same as a social act, and there is an underlying notion that by manipulating material culture, the individual is expressing some form of social power in that performance (Leroi-Gourhan 1993; Gamble 1998). Leroi-Gourhan and Lemmonier are often the most common scholars credited for the development of the *chaîne opératior* approach. Leroi-Gourhan (1993) believed that tools became real when they were in action, when they were animated by human gestures. He is credited with studying the transformative processes that lithic raw materials undergo during their use-life through comparative and experimental applications (1993). Lemmonier (1993:3) expanded upon this approach, noting further that the gestures involved in the use of a tool embody social ideas that are intrinsically linked to the overall social system in which an individual is associated. Lemmonier went on to document technological processes first-hand by ethnographically observing the transformation of raw materials into tools (Bleed 2001; Sellet 1993).

The *chaîne opératior* is defined properly as the "succession of mental operations and technical gestures, in order to satisfy a need (immediate or not), according to a preexisting project" (Perles 1987:23). Today, this approach considers the chronological sequence of events that occur during tool manufacturing and maintenance, describing all of the technological operations that are necessary to bring a raw material from a natural state to a manufactured one (Lemonnier 1992). By reconstructing the entire life history of a tool archaeologists may discover the processes involved in "techniques of production and, beyond that, the conceptual patterns from which they sprang" (Julien and Julien 1994:15). While this approach emphasizes artifact production, use, repair, and discard, the ultimate goal is to provide a more dynamic view of stone tool technology by addressing more specifically the human processes which bring artifacts from raw materials to items of material culture (Bleed 2001). The emphasis of this approach is the people, often the individuals, who were actively engaged in the processes associated with the use of technology (Close 2006:6). Perlés has divided this process into three stages: raw material procurement, tool production, and tool management (1992). The concern, however, during each stage in the process, is with the cognitive or decision making processes associated with tool use, rather than tool itself. Bleed (2001:108) and Julien and Julien (1994) argue that the *chaîne opératior* approach has been popular among archaeologists and social scientists because it offers a means to go beyond simple typological descriptions of stone tools to depict relationships between artifacts that appear to be morphologically distinct. It is also an approach that emphasizes the role that human agency plays in the production sequence, and has thus becomes increasingly popular among researchers interested in the more cognitive aspects of technology (Bleed 2001; Julien and Julien 1994).

The development of the technological organization approach, as one that emphasizes processes responsible for the production of archaeological materials, can thus be said to have been influenced directly by the *chaîne opératior* approach. In the several decades since the concept of technological organization was introduced into American archaeology, scholars have offered varying definitions. Koldenhoff (1987:154) defines an organization of technology as "the way in which a culture or society designs it tools and structures tool production, use, and maintenance, so that the tools can respond effectively to the demands placed upon them by the society in its daily interactions with the environment". Kelly (1988:717) adds that it also includes the behavioral variables contributing to differential spatial and temporal relations among various activities. As a methodology, it also aims to elucidate relationships between large-scale behavioral changes and technological changes within prehistoric societies.

Leblanc (2000:33) refers to technological organization as an "adaptive decision-making process", but one that cannot always be directly observed in the archaeological record because it "belongs to the behavioral domain". While certain social behaviors related to technological change and variability may not be visible at the macroscale, does not mean that they are not visible at the microscale. At the microscale, the focus is localized and often site-specific. There is an emphasis on the production, use, and discard of technology within a specific spatial and temporal context. As Dobres (1995) notes, "people often act differently towards one another depending on what they are doing, with whom they are doing it and where they are" (1995:25) and in many contexts there may be socially prescribed roles which prevent individuals from participating in the manufacture and use of certain technologies. For this reason it is necessary not to divorce technology from the social context in which it is produced and used, as they are "inseparably linked and should be studied together (Hughes 1979) – along with gender relations of production" (1995:29).

The factors (Figure 2.1) which not only affect technological organization, but are also affected by it, include: the environment, economic and social strategies, and technological strategies (Carr et al. 2012; Nelson 1991; McCall 2012). Carr et al. (2012) also add to this model population demographics. Each of these factors in turn introduce a number of constraints related to the procurement of raw materials, tool design, manufacture, and distribution, and the length of time in which a tool stays within the technological system before being discarded (Andrefksy 2009; Carr et al. 2012; Binford 1979; Kelly 1988; Nelson 1991). At present, models of technological organization do not explicitly include gender or gender relations as a variable or level analysis. This is rather problematic because gender has the potential to influence technology at any stage. Gender can, for example, function specifically as a social constraint

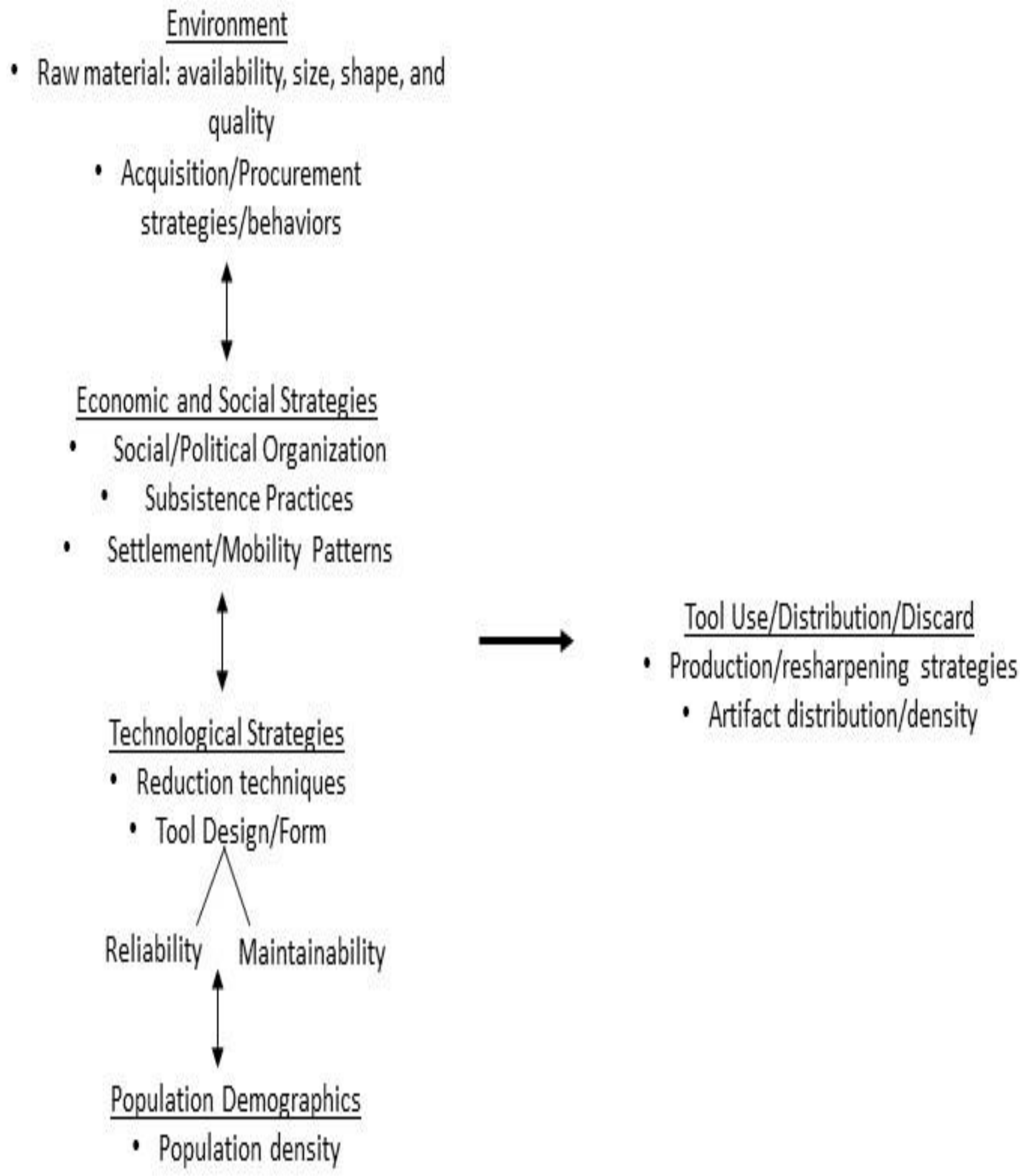


Figure 2.1: Model of Technological Organization (after Carr et al. 2012; Nelson 1991)

that directly affects the decision making process with regards to the manufacture, use, and discard of all forms of material culture. Biological sex, as well as age, would have contributed to such things as raw material selection, tool design, and even patterns of discard. It is important, therefore, to consider how differences in technology might be related to an individual's sex, age, and skill level.

2.3.1 Environment

The natural environment is one of the most important factors affecting human behavior and technological pursuits, particularly when it comes to the availability and access to resources and lithic raw materials. The intensity in which an environment will be exploited or occupied is often a direct response to resource predictability and productivity (Nelson 1991). Provisioning and procurement strategies will be affected by access to local raw materials, raw material size, shape, and quality. Technological choices in terms of raw material selection and tool design are often seen as being "responsive to conditions created by the interplay of humans and their environment" (Nelson 1991:57). Optimal foraging models have offered insight into technological organization and hunter-gatherer behavior by producing a series predictions with respect to expected foraging behaviors in different environmental circumstances (Winterhalder 1981). Because technology is intrinsically linked to subsistence practices, Kelly (1995) argues that foraging models can be used as explanatory frameworks to test theories of technological change. It has been demonstrated that hunter-gatherers will position themselves on the landscape and organize their technology to adapt to both immediate and anticipated needs (Kelly 1995; Winterhalder and Smith 1981). The manufacture, use, recycling, and discard of tools is thus intimately tied to land-use practices, and can be better understood when you take into account the totality of environmental and resource exploitation in the archaeological record (Andrefsky 2009; Carr 1994; Nelson 1991).

Technological strategies and organization may also be affected by the relative use of the landscape by gendered individuals, as the utilization of certain raw materials can be limited or prevented by gender and socially prescribed roles. Division of labor by sex and gender also affects the organization of individuals on the landscape and their technological needs, particularly when it comes to the types of tools required and their need beyond the task at hand. Culture, as Binford (1965:205) wrote, was differentially participated in, and the technology associated with men and women would have been the result of a series of technological choices defined by social, cultural, and perhaps physical constraints.

Individuals and groups can also organize the physical landscape as socially constructed places (Ashmore 2006) with gender boundaries. Certain locales on the landscape may have been perceived as gendered, and this can influence how they were used and by whom they are occupied (Hay-Gilpin 2003). Space thus becomes another physical source for gender construction and an arena for the performance and negotiation of gender (Stig-Sorenson 2000:144). The organization and control of space can function as a tool to maintain social divisions. By understanding the organization of space at different scales, from individual features to large-scale landscapes, it may be possible to identify gendered activities within a specific context (Stig-Sorenson 2000:146).

2.3.2 Economic/Social Strategies

Raw material procurement, tool manufacture, and tool use are embedded within the larger social and economic systems of hunter-gatherers, and studies of technological organization have focused heavily on understanding how changes within this larger system affect technology. It is recognized that the ways in which people situate themselves on the landscape in terms of their mobility, subsistence, and settlement practices, are often tied to the ways they organize themselves with respect to one another. Changes in subsistence, for example, may require the development of new economic strategies which lead to different perceptions of individual autonomy, changes in the organization of labor, and new responses to fluctuating or unpredictable resources. Such changes will affect technological organization, and could also have serious implications for all members of the group who depend on different types of technologies in their daily subsistence and economic activities.

Economic and social strategies consider kinship, political organization, and religion as primary factors influencing technological change (Carr et al. 2012), and there is evidence to suggest that material objects, like stone tools, debitage, or freshwater shells are seen not only as functional objects, but objects that can become charged with social and symbolic significance (Nassaney 1996). Claassen (2008) has suggested, for example, that marine and freshwater shell were imbued with a certain level of symbolism. Across North America, shells were thought to be associated with renewal and rejuvenation, related socially and symbolically to birth and new beginnings. Marine shell, specifically in the form of shell beads, were also viewed as a form of social-currency which carried a high social value, associated not only with important political figures but also religious specialists (Deter-Wolf and Peres 2014:170). Differential access to certain raw materials may reflect inequalities based on age, achieved social status, and gender. Material objects can be effectively used to define social distinctions and boundaries, and they can also serve to reinforce and maintain social divisions (Nassaney 1996; also see Gero 1989). It may be possible to recognize these distinctions archaeologically at the microscale, if there are observable patterns in the distribution of certain raw materials or artifacts.

2.3.3 Population Demographics

Only a few definitions of technological organization include population demographics as a level of analysis to understand technological organization. Carr et al. (2012), for example, have added demographics to their expanded model of an organization of technology approach; however, they define population demographics in terms of population size. They note that the formation of a lithic assemblage, including both the number of tools and types of tools found, is directly impacted by the number of people on the landscape (Carr et al. 2012:7). I would add, however, that it is equally as important to consider the sex and/or gender of the individuals on the landscape at any given time. Because men and women within hunting and gathering societies often allocate labor along lines of gender and age, they will utilize the landscape in different ways, expending their time and energy on tasks in which they are more knowledgeable and particularly skilled. The procurement of certain resources also means that men and women will tend to exploit different environments on both a daily and seasonal basis. After several years working among the Hidatsa in North Dakota, Spector noted that males and females participated in separate, often unrelated tasks, that they often utilized different geographic spaces, and that the volume and kinds of materials produced and used was sex-specific (Spector 1998:155).

Spector suggested that archaeologists use a task differentiation framework to determine the full range of activities engaged in by populations, as well as the organizational, spatial, temporal, and material characteristics of each. The observations can then be used to construct a series of activity maps, which highlight the spatial and temporal relationships between task actors, task organization, and the spatial dimensions of task differentiation (Spector 1998:154). This approach, which will be discussed further in Chapter 3, relies on a series of universal assumptions about gendered divisions of labor within hunter-gatherer societies. These assumptions consider more broadly the differential participation of men and women within a range of activities at different levels of production (Stig-Sorenson 2000:185-186). Spector's activity map, or task differentiation method, has the potential to distinguish between characteristics of spaces because it explores a range of activities and contexts where gender would have played an important role in differentiating material culture production and use.

2.3.4 Technological Strategies

The manufacture and use of certain tools is generally understood to be central to the ways in which hunter-gatherers organize their lives and adapt to constraints placed upon them by their environment (Binford 1979; Carr et al. 2012; Kelly 1988; Nelson 199). Technological choices are also predicated on the immediate needs of tool makers and users, use location, the anticipation of future needs, and the availability and quality of natural resources. Curated and expedient tools within any technological system, for example, serve different functional roles and these two types of technological strategies may be interwoven in different spatial/temporal contexts.

The concept of tool curation was originally introduced by Binford (1979) as a way of describing important aspects of technological behavior among hunting and gathering societies. This concept has since been adopted by archaeologists to describe tools and toolkits that are manufactured in anticipation of future use, maintained, and transported to and from multiple locations (Andrefsky 2009; Binford 1973; 1979). Curated tools are often identified as those tools that require an investment in time and energy, are considered to be technologically sophisticated and formally distinct, and the form or design is conceptualized prior to manufacture (Bamforth 1986:38). These are tools that are maintained, retouched, repurposed, and recycled to different tasks when they have exhausted their use (Bamforth 1986; Nelson 1991:60). Binford (1979, 1980) also linked the use of curated technology to settlement-subsistence organization, particularly among foraging societies who are constantly moving around on the landscape to meet subsistence and nutritional needs. Today it is recognized that tool curation is much more complicated and likely was dependent upon a number of factors, some of which include raw material availability, time constraints in terms of the amount of time it takes to manufacture a tool and the amount of time necessary to complete a given task, and location where tasks are to take place (Bamforth 1986; Nelson 1991; Parry and Kelly 1987).

In contrast to curated technology are those implements identified as expedient tools. Expedient tools have been defined as "tools that are manufactured, used, and discarded according to the needs of the moment" (Bamforth 1986:38). Many expedient tools are made with little or no production effort and are produced from locally available and abundant raw materials (Andrefksy 2005). When compared to curated tools, expedient tools are considered to be technologically simple and informal; they require little investment in tool design, minimal tool maintenance, and have a relatively short use-life (Andrefsky 2005:31; Bamforth 1986). Nelson (1991:65) notes that expedient technology can be completely opportunistic in nature, conditioned by specific environmental and behavioral contexts, and responsive to immediate needs. It can, however, also be planned in contexts where there is knowledge of the local environment and available raw materials. Planned expediency requires full knowledge of tool needs and potential use-related activities, and moreover considers the replacement potential of tools throughout the occupation. Binford describes these types of expedient tools as "situational gear" (1979:265). Situational tools, as described by Binford (1979:266), are those put together to accomplish a specific task or set of tasks. Raw materials may be sought from local caches or they may be manufactured from resources available in the immediate environment.

Expedient flake implements, however, are generally thought to contain less cultural information than formal retouched tools, such as bifaces and projectile points, despite having been utilized to accomplish many of the same tasks. Debitage and flaking debris, while providing valuable information regarding reduction strategies and techniques, also serve as potential caches for tool users and can provide information regarding the knappers intent on controlling flake shape (Holdaway and Douglas 2012:103). Holdaway and Douglas (2012) demonstrate that lithic reduction activities can be centered on the production of complicated tool forms as well as on the intentional production of a variety of flakes. Observations among some stone tool using societies show knappers intentionally sought to manufacture flakes of a particular shape and size as a consequence of core reduction. Among the Ngilipitji in Northern Australia, flakes were detached from cores and examined and tested for use in a particular task (Jones and White 1988:68). Binford (1979) described similar episodes of flake reduction activities, wherein the flakes retrieved and used from core reduction were by individuals other than the knapper. The selection of flakes for use was not by any means considered to be arbitrary or random, but flake users were known to select suitable forms using specific criteria likely related to the nature and intensity of the task to be completed (Holdaway and Douglas 2012:107).

Holdaway and Douglas (2012) effectively show that the goal of core reduction is not always the production of formal lithic tools, but rather can center on the creation of a variety of useful end products. The variability in flake shape and size would be viewed as desirable because it would provide tool users with a variety of tool forms to choose from. The selection of flakes for use was likely based on certain functional criteria related specifically to the task at hand. There may also have been some social significance pertaining to flake tool selection by individuals. Analyses of flake tool assemblages should focus on understanding the ways in which flake tools are utilized to meet functional needs, because recognizing patterns of use among different types of technologies may result in the tentative identification of various social and material contexts of artifact use and production (Dobres 1995:1995). It is important to remember that even the most technologically simple artifacts can be used to produce material culture that is not only technologically complex, but also socially and culturally significant (Holdaway and Douglas 2012).

Studies of lithic assemblages have found that there is not always a dichotomous relationship between curated and expedient tools, and in fact these terms tend to oversimplify the use of lithic technology in many contexts. Nash (1996:93) argues that the term "curation" has too many definitions and as a result it is too vague a concept to offer any sort of interpretative value. Others have argued that as soon as a flake is hafted it is no longer considered to be expedient, even if the flake is discarded shortly after use. In some contexts, nonretouched flakes were known to have been transported for future use, and therefore were considered to be worthy of curation in the future (Holdaway and Douglas. 2012). Nash (1996:93) has suggested, that it may be useful to eliminate using such terminology until more standardized definitions are developed.   Until that happens, researchers need to make explicit their definitions of expedient and curated technologies. The terms expedient and curated, as used in this dissertation, are used to describe tools based on the extent to which a tool is worked and utilized, aligning with the definitions above presented by Nelson (1991:65) and Binford (1979:266).

2.4 Engendering the Archaeological Record and the Origins of Sexual Divisions of Labor

Most archaeologists, past and present, acknowledge that gender has always played at least some part in the social organization of prehistoric societies. Within many ethnographically observed cultures, men and women are known to differentially participate in social, economic, political, and technological pursuits based on socially constructed ideas of appropriate behaviors (Bird 1999; Hawkes and Bliegh Bird 2002; Gould et al. 1985; Murdock and Provost 1973; Weedman 2010; Wood and Eagly 2002). Gender-related statuses and roles affect access to knowledge, experiences, and material culture, and because gender is enacted daily and permeates all aspects of the human experience, it becomes an observable dimension of social life. Gender relations encompass the social interactions between women and men, the exertion of political power or social influences, as well as the ways in which gender roles structure or determine adaptations to social, economic, or ecological factors (Hill 1998:104). Gender relations also include the ways in which prehistoric societies divided activities and work among community members, and whether any of those divisions suggested a sexual division of labor (Peterson 2002:3). The roles that men and women played within their communities, and their contributions to food and material culture production, often determined their status or helped to define their relationships within the group.

The earliest studies of gender and material culture in archaeology were motivated almost exclusively toward “finding” women in the past, elucidating their roles and contributions in society, and to finding evidence of their importance throughout prehistory (e.g., Ardener 1975; Beechy 1978; Boserup 1970; Dahlberg 1981; Draper 1975; Leacock 1978; Quinn 1977; Reiter 1975; Ross et al. 1978; Slocum 1975; Tanner and Zihlman 1976 among others). An interest in women in the archaeological record and gendered critiques in archaeological interpretations roughly coincide with emerging feminist critiques of androcentrism in the discipline (Conkey and Gero 1997; Conkey and Spector 1984; Wylie 1991). Feminist theories "analyze women's experiences, articulate the nature of social relations between women and men, and provide explanations that support efforts to transform these relations" (Swigonski and Raheim 2011:10–11). Feminism is often seen as evolving in three separate waves, each of which were influenced by, and influenced, changes in social theory and methods. The first wave was centered on national progress and women's freedom and equality to men (Swigonski and Raheim 2011:11). Within the discipline of archaeology, this wave was centered on finding women in the past. By the 1970's during the "second wave" of feminism, there was widespread recognition that many archaeological interpretations were based on ethnographic accounts which prioritized descriptions and interpretations of male-centered activities.

One of the major insights associated with the second wave of feminism was that many prehistoric interpretations overlooked the diversity of the human experience by preferentially focusing on the experiences of men (Stockett and Gellar 2006:5). Feminist scholars argued that by focusing on men and relying on perspectives of white-male ethnographers, there was an uncritical and unchallenged use of gender stereotypes in archaeological scholarship that supported and often perpetuated sexism, gender asymmetry, and universal cultural experiences associated with binary oppositions (Conkey and Spector 1984:3; Slocum 1975). Too often, for example, women were portrayed as being biologically and culturally restricted by their childbearing responsibilities, which by association restricted them exclusively to the private/domestic sphere (Brown 1970; Stockett and Gellar 2006; Ortner 1974). In contrast, men were associated with the public domain (Ortner 1974), and were typically portrayed as stronger, more aggressive, active, dominant, and in general much more politically and socially important than women (Conkey and Spector 1984:4). Males essentially represented culture and drove culture change, while women were portrayed as casual bystanders, who were weak, passive, and dependent upon their male counterparts (Conkey and Spector 1984). Within early archaeological scholarship, interpretations of gender roles often mirrored the gendered experiences of scholars at the time.

The second wave of feminism, and the influential critique of gender theory in the discipline by Conkey and Spector (1984), is often considered to be the starting point of gender studies in archaeology (Stig-Sorenson 2000). As a result, archaeologists and anthropologists not only began challenging existing interpretations about the past, but many researchers initiated new ethnographic studies in order to examine female participation and influence in various cultural contexts (e.g., Weiner 1976). Such studies made it possible to reassign value to "what was considered to be undervalued or downgraded elements of women's material culture" (2006:108). Studies undertaken as a result of feminist approaches to anthropology revealed a range of social and cultural practices and relationships between gendered individuals. While an engendered archaeology began with a desire to insert women into the past, during the last several decades the aim has been to explore how men and women interacted and more specifically how social structures affected these interactions in different sociocultural contexts.

Gender is now understood to represent a set of values that assign meaning to behavior and individuals, however, gender may be differentially defined depending upon the interpretive context (Stig-Sorenson 2000:52). The focus, therefore, should not be exclusively about men or women, but rather on the relationships between people and material culture in specific social or domestic contexts. Archaeological frameworks are thus not intended to be gender specific, but rather gender inclusive. As an archaeological focus, studies of gender now aim to elucidate gender relations and the ways in which gender is experienced and expressed through material resources. "It is through objects and their associated activities that gender is enacted and becomes an effective dimension of both personal and social life. Objects simultaneously represent and affect gender, and the use of objects always involves negotiation and social processes" (Stig-Sorensen 2006:114). While the role that gender played in the production of material culture will vary both temporally and spatially, it is now recognized that objects in the archaeological record can become material manifestations of gender based on their presence and distribution (Stig-Sorensen 2006).

When investigating the lifeways of prehistoric hunter-gatherers and early agriculturalists, archaeologists have had a tendency toward a dichotomous view of the division of labor, often referencing gender analogies, to support these interpretations. There are, however, many critiques that gendered roles are too often assigned without appropriate consideration for the cultural contexts from which they were derived. Kent (1998) has argued that archaeologists often assume that a rigid sexual division of labor characterizes all modern human societies, and thus they risk projecting their beliefs onto the archaeological record (1998:39). Even though the sexual division of labor is often described as one of the most basic organizing principles of human social behavior (Leibowitz 1986) it is important to not assume that a particular work pattern existed for hunter-gatherers or early farmers without providing adequate evidence and appropriate analogies.

The sexual division of labor is quite complex, and cross-culturally both men and women tend to be involved in the performance of a wide range of tasks, "including the harvesting of food and nonfood items, and the conversion of these items into clothing, tools, craft items, and numerous other useful products" (Brumbach and Jarvena 2006:175). How labor is allocated or shared among group members has been shown to differ depending upon environments, climatic conditions, and varying social factors (Ember 1975; Hiatt 1978; Nelson et al. 2006; Peterson 2002: Waguespack 2006). Scholars from diverse backgrounds, ranging from biological anthropologists to feminist historians, have not only studied these labor patterns but have also contemplated the origins and development of sexual divisions of labor (e.g., Bar-Yosef and Meadow 1995; Bender 1978; Hastorf 1991; Hodder 1990; Finlayson 2010; Fish 2000; Peterson 2002). It has been proposed, for example, that the foundations of sexual labor patterns are ultimately determined by biological differences between men and women, and thus date back to the earliest eras of hunting and gathering (Peterson 2002:2). In this view, the greater physical strength of males combined with females' burdens of pregnancy, nursing, and child care jointly predict who will carry out each task (Lerner 1986; Rosaldo and Lamphere 1974).

Flannery (1972) has suggested that the fundamental productive units within most prehistoric societies consisted of sharply divided single-sex task groups. Groups of men, he argues, hunted wild game, while women and children collected and processed plants foods (1972:25). Flannery (1972), along with many other scholars, assume that women's tasks included sewing, cooking, food processing, and production of perishables, while men manufactured stool tools and hunting implements. Henry (1989) provides a similar interpretation for the social organization of prehistoric hunter-gatherers. He argues, for instance, that women operated primarily within the domestic sphere, carrying out tasks which kept them tethered to base camps overseeing both social and economic needs of the community (Henry: 1989:213). Men, on the other hand, are viewed as highly mobile, engaging in long-distance trade, hunting and warfare, or political endeavors that kept them away from camps for long periods of time (1989:202). Even scholars who reject a strict biological imperative for the sexual division of labor, argue that institutionalized sexual labor divisions are a fundamental part of what it means to be human (Brown 1970; Leibowtiz 1986). Leibowitz (1986) argues that the divide between hunting as a male domain and hearth-based activities as a female domain, were in place more than a million years ago during the time of *Homo erectus*. This would suggest that the predisposition to divide labor between the sexes is an innate part of human nature, instinctual, and therefore universal within all human societies.

These types of scenarios, which appeal more often to the biological differences between the sexes, often present the sexual division of labor as a list of things that women cannot do, should not do, or are prohibited from doing (Jarvenpa and Brumbach 2006:97). They insinuate that women's immobilization is due to their reproductive roles and child care, a lack of strength, and lesser abilities than men. As such, they appeal to a masculine advantage for tasks that require greater strength or brief bursts of excessive energy (Murdock and Provost 1973). Child rearing and child care in general, have been seen as the primary elements structuring female labor in prehistory (Brown 1970). Brown contends that child rearing is widely construed as a female responsibility, and that certain tasks are more compatible with looking after children. These are activities that: (1) can be performed close to home, (2) require little concentration, and (3) are not dangerous (Brown 1970). Scenarios such as these, often receive substantial feminist critique citing case studies or ethnographic accounts in which the female reproductive role is not limited to participation in activities or tasks confined strictly to the domestic and maternal realm (Paterson 2002:141). While most scholars would agree that all observed human cultures are marked by some kind of differences between men and women, many question when, and through what circumstances, these marked differences between the sexes would have emerged within prehistoric societies. Some scholars have contended that gender became a recognized category of social identity by the Early Upper Paleolithic, when human figures and representations appear widespread in the European archaeological record (Beck 2000; Kuhn and Stiner 2006; Lupo and Schmitt 2002; Owen 2005; Soffer et al. 2000).

Within the last few decades, many have singled out the emergence of horticulture and agriculture as the primary means of inducing institutionalized sexual divisions of labor (Divale and Harris 1976; Lerner 1986; Peterson 2002). It is generally agreed upon that drastic economic and social changes occurred as human groups made the transition from hunting and gathering to farming or food producing economies. As groups reorganized themselves on the landscape to accommodate changing subsistence needs, many societies could have experienced unprecedented economic diversification, a proliferation in the manufacture and use of various forms of material culture, and greater elaboration and differentiation of social organization. In many cases, emerging agricultural societies would have experienced dramatic shifts in the roles and statuses of both women and men (Bruhns and Stothert 1999:76; Flannery 1972; Hurcombe 2008; Peterson 2002). The introduction and intensification of new activities associated with an increased reliance on domesticates would have necessitated changes in the allocation of labor among men, women, and children. Greater reliance on domesticated foods would have meant that more time be allocated to the planting, harvesting and processing of plant foods, the production of tools and containers associated with agriculture, as well as daily chores not necessarily associated with farming. While most authors seem to agree that agricultural lifestyles imply increased labor demands, "few seem to deal with the question, *who* is doing the agricultural work?"(Peterson 2002:33).

Bar-Yosef and Meadow (1995) suggest that gender-based activity differences would increase with the establishment of farming communities. He maintains that women would have been responsible for the new agricultural tasks and the production of associated material culture, while men would be increasingly involved in long-distance trade, politics, and hunting endeavors. As the differentiation of tasks became increasingly sex segregated between men and women, Bar-Yosef and Meadow (1995) contend that they also became spatially separate. Ethnographic and ethnohistoric sources have been used to support similar theories, often citing scenarios in which men and women within small agricultural economies have separate activity spheres and cases in which women are observed working in the fields doing most of the agricultural work (Bruhns and Stothert 1999). It has also been suggested that the increased divisions between men and women during the transition and establishment of agriculture led to the widespread social inequality between the sexes (Ehrenberg 1989, Peterson 2002), a position that has also been the subject of feminist critique.

If sexual labor patterns became increasingly segregated during the transition to agriculture, this does not also have to imply increasing stratification, subjugation, or oppression of women to men. Rather than accentuating the negative and often proscriptive aspects of the sexual division labor, the focus should be on what can be considered positive outcomes of such labor patterns. It is conceivable that the division of labor along lines of gender and sex was an adaptive strategy which led to the long-term survival of a community. Sexual labor patterns in reality represent strategic and highly adaptive allocations of labor that allowed families and small scale social units to perform a wider array of tasks that any one individual along could master (Jarvenpa and Brumbach 2006). “Specialized knowledge and expertise permit both men and women to make conscious choices about how best to allocate their labor in the face of fluctuating resources and changes in the composition of the workforce” (Jarvenpa and Brumach 2006:98). It is reasonable to consider that within communities where tasks are highly segregated by gender and sex, there is in place a functioning system of complimentary gender differentiation.

Many societies are successfully structured around differentiated roles that are conceived as “equal, contrasting, and complementary”, or heterarchical (Bruhns and Stothert 1999:80; Levy 2006). Within many ancient Native American societies, the “interdependences of women and men were fostered, gender complementarity was promoted by ideologies, and collaboration was enforced by special divisions of labor” (Bruhn 1999:80). Gender complementarity also would have permitted the development of greater expertise than would have been achievable through labor redundancy (Jarvenpa and Brumbach 2006:103), allowing for women and men to achieve economic specialization. Women’s participation in agriculture and related activities should be perceived as the purposeful investment of skill and knowledge, which could have afforded them greater voices in domestic and economic decisions and control over the allocation, and distribution of food and crafts. Claassen (1997) has suggested that women’s workloads were constantly being negotiated as new innovations were adopted, and that evidence for women’s active manipulation of their circumstances are evident in the adoption and invention of new technology, increases in birthrates, control over production, increase in status, and participation in ritual (1997:84). Their relationship to the land and control over plant resources would also have afforded women greater social and economic power.

It has been suggested by several scholars that women’s association with plants within many hunting and gathering societies, would suggest that they were responsible for experimenting with new species, intervening in the reproductive cycle of certain plant species, and eventually full domestication and farming (Bruhns and Stothert 1999; Claassen 1997; Fritz 1999; Watson and Kennedy 1991). If women had indeed been responsible for the independent development of cultigens, it is likely that their long established, and intimate relationship with plants would have persisted to perhaps become relatively fixed over time, or least during certain periods in time. By the time Europeans arrived, women were observed doing the majority of agricultural work and producing the vast majority of plant-based material culture (Hudson 1976). Early ethnographic accounts from the Southeast document labor systems wherein the fundamental division of labor was between men and women (Adair 1775; Hudson 1976; Swanton 1946). Hudson describes a system where men and women kept themselves separate from each other to "a very great extent", so much so that their separation helped to epitomize their sexual identity (Hudson 1976:260). While men and women were responsible for different tasks, it is noted that the activities varied according to the divisions of the year, and that these were seasonal emphases because subsistence was a year round pursuit. During certain times of the year, men were observed clearing agricultural fields, working alongside women, children, and the elderly.

Several ethnographic and ethnohistoric accounts have identified a diversity of labor scenarios, indicating that a gendered division of labor consists of diverse participants in a fluctuating and diverse set of relationships (Levy 2006). It is likely that sexed labor patterns fluctuated and were at times fluid enough to accommodate periods of subsistence stress or during seasonal planting or harvesting events which would have relied heavily on the labor of all able-bodied individuals. During the transition and intensification of agriculture, it is conceivable that sexed labor roles, and even social arrangements, were easily reorganized to accommodate new and changing subsistence activities, growing populations, larger trading networks, and more complex social organizations. Many authors attempting to study the origins and development of sexual labor patterns have suggested that there was a "uniform, developmental trajectory for sexual divisions of labor" as groups transitioned from foraging to farming (Peterson 2002:4).

Moore (1988) has opposed such an interpretation, arguing instead that sexed labor patterns are transformed and re-created in the context of specific sets of historic, economic, and social conditions.

Given the complexity and fluid nature of sexual labor patterns, scholars have found few successful avenues for exploring or firmly demonstrating these relationships archaeologically. Only one methodology with specific applications to gender has been developed to empirically establish whether certain tasks or patterns of activity can be assigned to one sex or the other. This task differentiation approach, developed by Janet Spector, was designed as means of testing many of the assumptions, assertions, and statements about women and gender relations in archaeological contexts. Spector (1993, 1998) argued that archaeologists have typically given more attention and assigned more importance to men and presumed male activities than to women and their presumed activities. She contends that women were consistently being portrayed as dependent and tethered to domestic duties, while men were characterized as independent and capable of making decisions in the public domain (Spector 1993). Her goal was to challenge those orthodox notions about hunting, food gathering, farming and childcare that many archaeologists had treated as "single, invisible actions rather than multitask activities organized in various ways" (Spector 1993:9). Task analysis was one way to show how men and women might have responded differently to changes in their natural and social environments, depending on the tasks they performed, when they did them, and where they lived (Spector:1993:9).

The development of the task differentiation approach began with a series of questions about possible connections between the material and non-material dimensions of gender.

> How do various cultures use material things such as tools, clothing ornaments, and decorations to signify differences between men and women? How do the activities of

> male and female adults and children affect the physical layout of their working and living spaces and their communities? How do objects reflect and reinforce gender-based differences in power and status? How are objects used to socialize children about culturally appropriate male and female roles? (Spector 1993:9)

Additionally, Spector wondered how male and female roles, beliefs, and social interactions would be represented or preserved within archaeological contexts, and moreover how archaeologists would determine if both men and women were present at any given site (Spector 1993:9). Using historical and ethnographic sources from four different Native American groups, and on a task-by-task basis, Spector examined male and female activities associated with acquiring and processing food, making and repairing tools, clothing and buildings, and the processes involved in maintaining social relations (1993:9). She hypothesized that men and women in a given population "might respond differently to changes in their social or natural environments depending on the kinds of tasks they engage in, the geographical spaces they utilize in the performance of tasks, the scheduling of their tasks, and the materials they use and/or produce as part of their task assignment" (Spector 1993:80). Theoretically, the use of this approach would enable archaeologists to identify similarities and differences in the activity patterns of males and females with most archaeological contexts.

The process of recognizing women and gender in the archaeological record, therefore, requires that archaeologists examine all possible relationships between activity patterns of males and females and their activity setting in ethnographically known contexts (Spector 1998:146). The process requires that researchers play close attention to who performed each task, when, where, and how frequently tasks occurred, and what materials, artifacts, facilities and structures were associated with each activity (Spector 1998). This information can then be used to investigate male and female task differentiation in the archaeological record using artifacts, structures, and facilities that men and women may have used as part of their task assignment.

Critical evaluations of the task differentiation approach have revealed several potential problems and biases. Conkey and Gero (1991), for example, explicitly reject the approach on account that it “assumes absolute sexual divisions of labor exist”, and that “it implies that gender roles are immutable rather than adaptive” (1991:109). Spector herself discarded the approach after encountering serious biases in documentary sources, and later finding the approach too constraining. She writes that “like other taxonomic schemes, it generated distance and lifeless representation of the past (1993:17). Hill (1998) has also argued that methods which rely too heavily on ethnographic analogies and a gendered association of artifacts are too reductionist, denying the embeddedness of gender in social situations and ideologies (1998:109). These approaches, she argues, often deny change in gender roles as potential adaptive consequences and assume that women and their roles are stable (1998:111). Even with many of the problems identified, the task differentiation approach continues to be utilized by scholars studying gender in the archaeological record. It is, nonetheless, often modified or adapted to fit a suite of specific archaeological problems and questions, but more importantly, scholars are incorporating more lines of evidence and using the approach to test specific hypotheses.

Although Hill is critical of an overreliance on ethnographic analogies, she maintains that ethnographic and ethnohistoric evidence can still be used to generate hypotheses to test archaeologically (Hill 1998:115). She proposes that two or more lines of evidence, mutually exclusive or independent, be examined critically in an effort to formulate testable models and questions. A multivariate approach, Hill argues, should provide the basis for disconfirmation and “rather than having several lines of evidence suggesting certain changes in the organization of gender relations, these hypothetical changes can actually be tested using the archaeological evidence" (1998:118). It has been suggested that researchers continue to reference ethnographic and ethnohistoric data to make inferences regarding gender and gender relations in the past. Throughout this chapter I have attempted to contextualize the way in which gender theory can be used to inform the study of technological organization. I have attempted to show that it is possible to analyze material culture to generate hypotheses regarding associations and relationships between artifacts, gendered individuals, and social divisions within specific spatial and temporal contexts. I focus on lithic technology, more specifically expedient flake tools, because of their ethnographic association with women and domestic tasks. While functional definitions of artifacts will include the possibility of their use by both men and women, I hypothesize that the differential use and distribution of flake implements throughout each occupation at Mussel Beach site is the result of changes in population demographics and increases in divisions of labor associated with the increased reliance of plants for food and perishables material. It is highly probable that the shifts in mobility to more long-term settlements associated with garden economies would have led to an increase in the production of storage technologies, the use of containers, and the production of household mats. As a result, I believe that the visibility of perishable material culture, particularly the processing and manufacturing, should increase as groups occupy locations for longer periods of time. In the next chapter, I describe the ways in which perishable artifacts are identified in the archaeological record, and how these artifacts are analyzed in their various states of preservation. In the next chapter I also explore plant use among prehistoric people throughout North America, but I focus explicitly on plant use for perishable artifacts and not subsistence activities. Women's association with perishable material culture in ethnographic and ethnohistoric contexts will also be addressed.

Chapter 3: Perishable Material Culture and Split-Cane Technology in the Archaeological Record

Perishable material culture encompasses any object manufactured from organic raw materials, including wood, bone, animal fibers, and plants. Except for in exceptional preservation contexts, perishable artifacts traditionally do not survive as archaeological specimens and are therefore underreported as part of the archaeological record (Drooker 2001; Peterson 1996; Wobst 2001). Excavations at sites where conditions are favorable for organic preservation, including water-logged sites and dry caves and rockshelters, demonstrate that perishables often outnumber stone tools 20 to 1 (Adovasio et al. 2007; Soffer et al. 2000; also see Taylor 1966) and can make up more than 95% of the total material culture recovered (i.e., Andrews et al. 1988; Croes 1997; Dillehay 1989; Drooker 1991; Kuttruff et al. 1998; Sibley et al. 1996). Basketry and other fiber technologies are known to be one of the oldest non-lithic forms of technology represented in the archaeological record (Adovasio 1977). In the Old World, perishables manufactured from plant fibers are in use in the Upper Paleolithic Europe by at least 26,000 years ago (Adovasio et al. 1996; Adovasio et al. 2001). In North America, plant and fiber technologies were widespread by the early Holocene (Andrew and Adovasio 1993: Chapman and Adovasio 1977; Ford and Willey 1940; Styles et al. 1983), but limited evidence suggests perhaps a Pleistocene antiquity (Adovasio et al. 2003; Wilson 1889).

In this chapter I will discuss some of the ways in which perishable technology is identified in the archaeological record. I describe many of the ways in which perishable artifacts are analyzed and reference several studies which have attempted to move beyond descriptive classifications of these artifacts to include information on social and symbolic meanings associated many perishable items. I also investigate how, in the absence of well-preserved archaeological specimens, archaeologists can infer the production and use of perishable technology in the past. I next explore the various types of plants utilized by prehistoric people throughout North America, and emphasize specifically the importance of river cane in the production of perishable material culture among Southeastern Indians. Included in this section is an overview of the experimental ethnoarchaeological program designed and implemented as part of this dissertation. Lastly, I discuss the importance of women's labor in the production of perishable industries, specifically their role in the harvesting and processing of plant materials for basketry and plant-based technologies.

3.1 Studies in Perishable Technology in the Archaeological Record

Throughout prehistoric North America, the manufacture of perishable material culture represents localized adaptations to the environment and the pursuit of a technology that required intimate knowledge of landscapes and material resources. Although recovered in all parts of North America, much of what archaeologists have learned about early basketry and fiber technologies in the archaeological record comes from western North America and the Great Basin region (Adovasio 1977). In these geographic regions there are not only a number of preserved specimens, but there exists a rich ethnographic, archaeological, and historic record directed to their study. Unfortunately, as a whole much less is known about early perishable technology throughout North America compared to other, nonperishable classes of material culture. While preservation conditions account for much of this disparity in knowledge, Wobst (2001:46) maintains that the marginalization of perishables in archaeological practice is not sufficiently explained by the perishable nature of organic artifacts. Many scholars have in fact argued that perishable industries have been neglected in the past because they are included among a suite of technologies produced and used by women and children (Adovasio et al. 2001; Brumbach and Jarvenpa 2006; Conkey 1991; Drooker 1991; Gero 1985; Hurcombe 1995; 2014;

Owen 1994; 1998; Soffer et al. 2000; Stig-Sorrenson 2006). Women's work within foraging societies has historically been unreported, or recorded in less detail, in comparison to men's. This reveals, to some degree, the biases and agendas of early male ethnographers, missionaries, and travelers towards activities associated with hunting and men's work (Conkey 1984; Conkey and Spector 1984; Hurcombe 1995, 2014; Owen 1994, 2000, 2005). By emphasizing the study of perishable fiber technologies in the archaeological record, researchers are showing a growing concern for marginalized forms of material culture and by association, women's work in many prehistoric contexts.

3.1.1 Defining Perishable Plant Industries

Plant fiber industries include, but are not limited to, basketry, matting, fabrics and textiles, netting, cordage, and other cordage-type constructions (Peterson 1996:2). The primary differences between each class of material culture are the processes associated with their construction and the overall form of the final product. Basketry, for example, is often treated as a subclass of textiles, but is considered a distinct technological industry because of manufacturing techniques (Adovasio et al. 2001). Basketry is defined by its rigid and semi-rigid form, and includes containers, baskets proper, matting, and bags. Baskets are traditionally constructed from unspun fibrous materials, such as unprocessed bark, strips of cane peels, or twigs that have been manually woven. While mats are generally flat, or two dimensional, most baskets and containers are three dimensional in shape. Textiles, in contrast, refer to items made from pliable, spun fibers, whose construction is accomplished with the aid of a frame or loom. Textiles include bags, cloth, and some types of netting (Adovasio 1977; Adovasio and Gunn 1977:137; Adovasio et al. 2001; Andrews and Adovasio 1980; Drooker 1992; also see Emory 1966).

Analytical techniques utilized in the study of perishable industries depend heavily on the size and conditions of the remains, as well as on the research questions being addressed. At present, there is no standardized method, or mutually exclusive classification system, employed for studying plant and fiber technologies (Peterson 1996). In general, textile research is divided into three broad categories: 1.) conservation and preservation; 2.) technical description; and 3.) cultural interpretations (Kuttruff 1997:141; Strickland-Olsen et al. 1999). Conservation is always a priority when analyzing organic artifacts. From the moment they are excavated, it is necessary that specimens are handled and stored correctly to ensure future preservation and analysis (Gardner 1996:174). Studies which focus on technical descriptions rely on physical and chemical analyses in order to identify raw materials, understand and describe specific technological or structural attributes, document morphology and style, decorative elements and embellishments, use, degradation, and age of the specimen (Kuttruff and Strickland-Olsen 2000:26). In most cases, textiles and baskets will retain at least a few diagnostic attributes that can be used for identification and classification purposes.

Attributes are defined by Adovasio (1977:1) as features of manufacture that reveal information regarding specific techniques of production. Baskets are traditionally divided into technological types based on weaving techniques, shared attributes, or clusters of attributes. There are three primary sub-classes of weaves used to produce different types of baskets, and these are considered to be mutually exclusive and taxonomically distinct (Adovasio 1977:1). Weaves include those that are twined, coiled, and plaited, and within each sub-class there is the potential of additional technological types. Twinning refers to a technique wherein the weaver moves horizontal wefts around vertical elements, called warps. Coiling, in contrast, involves the sewing of stationary horizontal elements, called the foundation, with moving vertical elements, referred to as stiches. Finally, plaiting involves a number of single elements, called strips, being passed over and under each other at a relatively fixed angle (Adovasio 1977; James 1903; Mason 1970). The ability to recognize differences in the technological attributes of baskets and other fiber artifacts is important because many attributes are localized or regionally specific, and therefore become culturally diagnostic. Turnbaugh and Turnbaugh (1986) note that baskets produced by native peoples throughout North America exhibit a great deal of technological and stylistic variability. Between cultures and across vast regions in both time and space, no two baskets are exactly alike, and many, although similar in form, exhibit differences in decorative elements, function, and raw materials (Turnbaugh and Turnbaugh 1986:66). Technological information, including specific weaving techniques, can yield information related to technological difficulty, area of occupation, subsistence practices, intergroup relations, trade, kinship, and social structure (Adovasio 1977; Adovasio and Gunn 1977). In some regions, baskets can also serve as chronological markers and can be used to reconstruct culture histories (Adovasio and Gunn 1977).

Regardless of construction techniques, plant fibers have been transformed into material culture to fulfill many of the basic needs of people in the past and were incorporated into aspects of domestic and ceremonial life, becoming imbued with technological, economic, and symbolic significance. Many perishable objects had the potential to express information beyond subsistence and utilitarian functions, conveying information related specifically to identity and ethnicity, social status, gender, and cultural boundaries (Adovasio et al. 2007; Costin 1996; Hill 2006; Masolowski 1996; Sibley and Jakes 1989; Sibley et al. 1996; Valoma 2013). These social dimensions, however, are far less understood and less frequently analyzed than traditional technological or stylistic attributes. Studies of cordage twist and twining weft slants have, for example, attempted to delineate cultural groups (Johnson 1996; Maslowski 1996), learning networks (Peterson 1996), social boundaries (Peterson et al. 2001; Peterson and Wolford 2000), and even individual makers (see Adovasio and Gunn 1977; Emery 1952; and Osborne and Osborne 1954). Minar (2000) also reasons that the final twist direction of cordage is dependent upon multiple factors, including the teaching and learning process, gross motor skills, efficiency and practically, and lastly cultural, religious, and symbolic beliefs about directionality. She cites that among many weavers, spinning direction is linked to symbolic actions believed to affect health and economic status, as well as protect against witchcraft or sorcery. Understanding why certain manufacturing techniques are common among different populations requires that analysts focus not only on recording twist direct, but the various cultural processes that are associated with cordage manufacture (Minor 2000). Cassman's (2000) analysis of textiles associated with mummified remains recovered from three pre-Inca (A.D. 900–1400) sites in Chile, demonstrates that differences observed in preserved clothing and textiles can often signify differential social status and access to resources. Similarly, the analysis of fabric fragments from the Etowah site in Georgia, revealed that the specimens were the surviving portions of a mantle or kilt, believed to have been a ceremonial garment worn by an individual on special occasions to signify political or religious status (Sibley et al. 1996).

Analyses of plant and fiber-based material culture from the archaeological and ethnographic record reveal the technological and cultural complexity associated with the manufacture of basketry and textiles, as well as the diversity represented in both form and function. When recovered in archaeological contexts, there is a wealth of information that can be derived from studying prehistoric textiles and the methods of analysis will likely vary according to the goals of the investigator. Ultimately, however, the information available is predicated on the nature of the sample and the conditions in which perishables are recovered.

3.1.2 Preservation of Perishable Artifacts in the Archaeological Record

With regards to preservation, perishable artifacts tend to be best preserved in dry sites like caves and rockshelters, as well as in wet sites that have been completely waterlogged or saturated. In the Southeastern United States dry sites have produced a number of perishable artifacts in varying states of completeness and preservation. The Ozark Bluffshelters on the Ozark Plateau for example, have yielded exceptional collections of textiles, including coiled basketry, baskets manufactured using traditional plaiting techniques, as well as twined fabrics. The analysis and documentation of perishable industries and plant remains from the various Ozark Bluffshelters have been ongoing since the early 1900's (see Fritz 1986; King 1975; Kuttruff 1988; Kuttruff et al. 1998; Scholtz 1975). A recent dissertation study conducted by Elizabeth Temple Horton (2010) detailed the chronology of fabric techniques in the Ozark Highlands. By documenting and studying the patterning and variability in textile design and technique, Horton sought to measure the usefulness of observable material attributes as indicators of temporal change and cultural continuity within upland communities (Horton 2010:66). Horton's synthesis of basketry technologies and perishable industries document the extensive use of plant-based technology in the Southeast from at least the Late Archaic through the Mississippian periods (Horton 2010). Studies such as this are critical to our understanding of plant-use as both a source of subsistence and material culture throughout prehistory in the region.

Additional dry sites in the Southeast which have yielded a range of textile and fabric specimens, include Russell Cave (Griffin 1975), Arnold Cave, Big Bone Cave, Salts and Mammoth Caves, and Bay Springs rockshelters (Webster and Drooker 2000:7). One of the oldest reliably dated fragments of basketry recovered in North America, however, comes from the Northeastern United States. At Meadowcroft Rockshelter in Washington County, Pennsylvania, archaeologists found a wall fragment of a plaited bark basket that was radiocarbon dated at 11,300 ±700 14C yr B.P. (Adovasio et al. 2003; Stiles 1982:133). Additional basketry fragments recovered from Meadowcroft Rockshelter were derived from a lower Strata and were dated to 19,600 ± 2,400 14C yr B.P. (Adovasio et al. 2003), which likely pre-dates the arrival of human populations in North America by several thousand years.

Waterlogged sites in the Southeast are much less common, although when found they offer a glimpse into a past that is not often possible in other archaeological contexts. The Windover Pond site in Brevard County, Florida represents one of the most unique and important sites in the region for the study of perishable material culture and prehistoric lifeways during the Southeastern Archaic. Preserved within a saturated peat matrix were over 100 human internments and associated artifacts dating roughly between 7,100 and 7,330 14C yr B.P. (Doran 2002:72). Associated with the human burials were a total of 87 perishable fiber artifacts, which included samples of twined basketry, twined and plaited textiles, and spun, twisted, and braided cordage (Andrews et al. 2002:132). Many of the textile specimens have been interpreted as mortuary shrouds and the cordage is believed to have been used to secure the bodies in their subaqueous graves (Andrews et al. 2002:163).

In the absence of direct evidence and well preserved artifacts, archaeologists have been able to infer the use of basketry, textiles, and fabrics through more indirect means. The three most frequently encountered categories of indirect evidence include skeuomoprhs, pseudomorphs, and impressions (Drooker 2001:171). A skeuomorph is defined as an ornamental design or decorative element on an artifact resulting from the nature of the material used or from the method of working it (Hastrof 2001:34). Archaeological skeuomorphs can include the impressions of netting and grass twine on ceramic vessels from their use as support during vessel manufacture. Ethnographic observations have documented mat impressions on the base of ceramic vessels and the use of various types of basketry, netting, and cordage as supporting elements during pot construction (Hurcombe 2008:95). Skeuomorphs can also include a class of artifacts that are manufactured intentionally to mimic the exact form of another object (Knappett 2002). Some pottery, for example, was intentionally constructed to imitate basketry and early gourd vessels (Hurcombe 2008, 2014). Pseudomorphs are essentially a "natural positive casts of a portion of a larger specimen as opposed to a negative impression of an item produced by impressing the original into compliant medium or matrix" (Adovasio et al. 2003:274). Pseudomorphs form when the specimen is completely encased within a matrix and subsequently dissolves or disintegrates and is then infilled with various minerals. The mineralized artifacts or fragments replicate the structure of the original object and essentially become natural equivalents, making it possible to discern many technical and structural elements of the original artifact (Adovasio et al. 2003:274; Drooker 2001:171; Sibely et al. 1996:73).

Impressions of perishable artifacts are frequently recovered in various archaeological contexts. It is extremely common in the Southeastern United States to find ceramic vessels and fragments whose exterior surface exhibits impressions of cordage and fabrics. Impressions can result by accident, they can occur as a consequence of the production process, and they can be deliberately added as a decorative element (Hurcombe 2008). In many instances, the impressions preserved in the clay surface allow analysts to record the structure of the cordage. In order to do so effectively, it is often necessary to create positives of the preserved cordage impressions. Positive impressions, or casts, create a more uniform surface that can reveal details which would have been otherwise unobservable (Hurcombe 2008, 2014; Johnson 1996:150).

Once casts are produced they can be analyzed to determine the specific ways in which fibers have been manipulated, i.e., spun and twisted (e.g., Maslowski 1973; Hurley 1979) to form the final product. The use of positive impressions also makes it possible to analyze tightly woven fabrics and discern details such as fabric stitching, embroidery, or knotting. Throughout the Southeastern United States, fabric-impressed ceramics are recorded by at least the Late Archaic, but become more frequent around 2,700 B.P. (Sassaman 2002:418). Cord-marked ceramics also appear during the Early Woodland period around 3,000 B.P. and spread throughout the region (Sassaman 2002:418).

In archaeological contexts, impressions of perishable artifacts are not confined to ceramic vessels alone, but are often found on prepared hearths and other surfaces, fragments of fired clay, within archaeological fill, and in rare cases impressions have been observed on antler and bone (see Sakharov 1952). Some of the earliest evidence in the world for textile production are impressions recovered from several Upper Paleolithic sites in Europe, including Pavlov I, Dolní Vêstonice I, and Dolni Vêstonci II (Adovasio et al. 1996, 2001; Soffer et al. 2000) and several artistic representations depicting tightly woven textiles. In North America, impressions of basketry and textiles have been recovered at numerous archaeological sites dating as far back as the Archaic period. Negative impressions of textiles and basketry were recovered on 29 prepared hearth surfaces at the Icehouse Bottom site in Monroe Country, Tennessee. The impressions are believed to be representative of both globular bags and rectangular mats. Radiocarbon assays obtained from associated charcoal samples dated the deposits between 9,450 – 9,250 ^{14}C yr. B.P. and firmly placed the specimens in the Early Archaic, *ca.* 11,500 – 3,200 cal. yr. B.P. (Chapman and Adovasio 1977). Similar impressions were observed on prepared clay surfaces from the Dust Cave site in northern Alabama. Although limited to small fragments, the impressions indicated the presence a textile exhibiting plain twining over a single warp, which is structurally similar to split-cane technology (Sherwood and Chapman 2005:75). Radiocarbon dates indicate that the impressions identified at Dust Cave are associated with the Middle Woodland occupation at the site. Sherwood and Chapman (2005:76) suggest that the presence of textile impressions on prepared hearth surfaces at both Icehouse Bottom and Dust Cave indicate that the impressions may have been produced intentionally during surface preparation. It is suggested, for example, that the impressions served a functional role to texture the surface in order to facilitate more effective absorption and dispersal of heat and to help maintain higher temperatures for extended periods of time. It is also noted that the impressions could have been formed during the transportation of clay to the site (Sherwood and Chapman 2005).

There is also indirect evidence to suggest that plant-based technologies were in use in North America during the Pleistocene. In 1996 a single positive impression of a basket or textile fragment was discovered in sediments excavated from Pleistocene-aged clay deposits at the Hiscock site in Genesee County, New York. The specimen is not a traditional impression, but is considered instead to be a pseudomorph, as the majority of the original fibers disintegrated and the negative space that remained was infilled with fine silt and clay-sized sediments. While the specimen was believed to have been derived from a deposit dating to the late Pleistocene, it was not recovered in situ, but rather in a screen, and the exact provenience remains ambiguous. Accelerator Mass Spectrometry (AMS) dates obtained from a twig and sample of unidentified plant tissue located within the matrix of the specimen produced an uncorrected date of 10,180 ± 50 ^{14}C yr. B.P. and 7,950 ± 50 ^{14}C yr.B.P. (Adovasio et al. 2003). The earlier date would place the specimen in the Late Pleistocene, while the latter date is associated with the Early Holocene.

The preservation of perishable artifacts such as skeumorphs, pseudomorphs, and impressions have allowed archaeologists to study various forms of organic technology. Even in the absence of direct evidence, researchers have attempted to understand technological and stylistic variability at various regional and temporal scales. Although studied much less frequently, additional lines of indirect evidence for the manufacture and use of perishable artifacts comes from usewear analyses conducted on tools believed to have been utilized in their production. Tools used in the manufacture of basketry and textiles by hunter-gatherer and horticultural groups in the Old and New Worlds is not well documented in the ethnographic record, although tools recorded range from awls, needles, paddles, and knives (Newman 1974).

Ethnographic collections have been useful for identifying and documenting wear patterns associated with the production of plant-based technologies. Soffer (2004), for example, studied diagnostic edge damage on a large collection of tools used to produce cordage and textiles by 30 different cultural groups located in North America, Alaska, and Siberia. Based on the wear patterns observed on the ethnographic tools, Soffer determined that several bone and ivory implements recovered from Upper Paleolithic sites exhibited similar forms of wear, including linear scratches and linear striations and plant polish. The archaeological specimens were tentatively identified as weaving sticks, mat needles, and net spacers (Soffer 2004:410). A similar study conducted by Elizabeth Stone (2011) examined archaeological, ethnographic, and experimental bone tools in an effort to differentiate the wear that resulted from use of bone awls on animal fibers versus plant fibers. In each example the authors demonstrated that patterns of wear develop on bone tools used to manipulate plant fibers, and furthermore that the wear observed is diagnostic of use action and materials worked. Both studies, however, focused exclusively on bone tools that were used to physically weave fibers, but were seemingly not involved in the harvesting or processing of plant-fibers prior to construction.

When considering the manufacture of baskets and textiles, one aspect that has been under studied is the harvesting of plant materials from the natural environment and the processing of those fibers for use as a construction material. Contemporary basket weavers use modern metal tools to prepare traditional basket materials, but prior to the arrival of Europeans the technology utilized would have been from manufactured from available resources. There are some references, for example, to the use of more traditional tools in the processing of plant fibers, including special cane knives (Colvin 2006:78; Swanton 1931:40), mussel shells (Newman 1974:27), and chert and obsidian blades (Anderson 1995; Hill 1995; Valoma 2013). Given the abundance and ubiquity of stone tool use within prehistoric societies, and the tough and fibrous nature of many of the plants utilized, it would not be surprising to find that a number of stone tools were used during some stage in the manufacturing of plant-based material culture.

Linda Hurcombe's (1992, 1994, 2008, 2014) experimental work has focused almost exclusively on the documentation of wear patterns on stone tools used in the processing of plant materials in the production chain of baskets, textiles, cordage, and netting. With a focus primarily on plant-based technologies in Mesolithic and Neolithic Europe, Hurcombe collaborated with a professional basket maker to implement an experimental program designed to investigate wear traces left by cutting, splitting, and scraping soft plants. The results concluded that subtle wear distinctions were discernable between many plant species, but the development of wear was dependent upon plant species worked, toughness of the plant, portion of the plant processed, season of harvest, and the intended use. Juel Jenson (1994) also found that relative levels of silica content in plants affects the formation of wear on lithic artifacts, noting that plants with higher levels of silica produce wear traces on stone tools much faster than plants with less silica. Among the plants tested by Jensen were different species of reed and nettles. In each instance substantial wear developed, but the extent was dependent upon the maturity of the plant processed and the water content. While extremely promising, the experiments conducted by Hurcombe (2008, 2014) and Jensen (1994) confirmed that the identification of plant materials on lithic artifacts is possible, but analysts should be cautioned as the wear produced from many species of soft plants often resemble one another under both low and high power magnification, which can complicate wear identification. These studies reiterate that all forms of technology are produced as the result of cultural processes and many may be associated with forms of material culture that did not survive in the archaeological record.

3.2 Plants as Material Culture

Ethnographic and historic accounts among many indigenous communities throughout the world document the use of thousands of plant taxa for subsistence, medicinal purposes, fuel, building materials, tools, and as raw materials for the production of various fiber technologies (Anderson 2005; Huckell and Toll 2004; Hurcombe 2014; Moerman 1998). Moerman's 1998 anthology provides perhaps the most comprehensive report of plant use by native populations throughout North America, documenting 2582 species of plants that were used medicinally by Native Americans, 1649 used for food, and 442 that were utilized for fiber or dyes. An additional 1074 species of plants used did not fit comfortably into the primary use categories, and include plants utilized for hunting and fishing supplies, incenses and fragrances, fuels, tools, and plants used for ritual or ceremonial purposes (1998:17). Moerman found that there was often considerable overlap of species between the various categories, with many containing not only nutritious and edible parts, but inedible parts that provided raw materials for perishable technologies (Moerman 1998).

As previously noted, some of the earliest examples of perishable technologies recovered in archaeological contexts were produced from plant fibers (see Adovasio et al. 2003; Chapman and Adovasio 1977). Various grasses, herbs, stems, leaves, and chutes have been used to produce all manner of perishable material culture and indigenous peoples have spent thousands of years working with, experimenting, and manipulating plant fibers. The types of plants utilized and technologies produced were dependent upon the environment and natural properties of the plants available, as well as cultural perceptions of plants and their material properties. In California and on the Northwest Coast, for example, baskets and textiles were furnished from a wide range of "wild" grasses, including bear-grass (*Xerophyllum tenax*), various species of sedge (*Carex* spp.) and tules (*Schoenoplectus* spp.), and deergrass (*Muhlenbergia rigens*). Woody basketry materials included buck brush branches (*Ceanothus cuneatus*), willow (*Salix* spp.), deer brush (*Ceanothus integerrimus*), dogwood (*Corunus* spp.), and oak (*Quercus* spp.) (Anderson 2005:192-219). In Arizona and New Mexico, in addition to many of the species mentioned above, baskets were manufactured from maidenhair fern (*Adiatum pedatum*), sourgrass/squawgrass (*Xerophyllum tenax*), sugar pine (*Pinus lambertiana*), devils' claw (*Martunia frangrans*), cattail (*Typha augustifolia*), and sumac (*Rhus trilobata*) (Newman 1974).

3.2.1 Plant Use among Southeastern Indians

The Southeastern United States represents a diverse culture area defined by five major geographic or physiographic regions: the southern Appalachian Highlands, Interior low Plateau, the Piedmont, Ozarks, and the Coastal Plain (Gettys 1984; Smith 1986:3-6; Steponaitis 1986:364). Within each region there is considerable diversity in the distribution of flora and faunal communities and observable differences in the utilization of plant materials for perishable industries by prehistoric and contemporary native populations. Throughout the Southeast, written accounts document the use of a wide range of grasses, herbaceous plants, and bast fibers for the production of various items. There are, for example, references to the use of papaw/pawpaw (*Asimina* spp.), willow (*Salix* spp.), walnut and hickory (*Juglans nigra* and *Carya* spp.), mulberry (*Morus rubra*), milkweed (*Asclepias* spp.), dogbane (*Apocynum* sp.), nettle (*Boehmeria* sp.), cattail (*Typha augustifolia*), and cane (*Arundinaria* sp.) (Clayton et al. 1993; Hamel and Chiltoskey 1975; Layne 1996; Swanton 1911, 1931, 1942; Whitford 1941). While perishable artifacts manufactured from many of these species have been recovered in the archaeological record throughout the Southeast, only a few species continued to be utilized for perishable technology into the historic period

3.2.2 Split-cane Technology

River cane (*Arundinaria gigantea*) represents one of the few plants whose cultural importance extends from at least the Late Archaic, through the historic era. Cane (*Arundinaria* spp.), which is not only the largest native grass in the US, is also the only indigenous species of bamboo found in the continental United States (Connor 2004; Triplett et al. 2006). Described as a woody, rhizomatous grass, cane possesses many of the same basic characteristics as bamboo, but can be distinguished based on its macro-morphology and geographic distribution. As a species, cane is confined to only the Southeastern portion of North America, occurring from the Coastal Plain from New Jersey south to Florida and west to Eastern Texas and inland through the Piedmont and lower elevations of the Appalachian Mountains (Tripplett et al. 2006:80). Although there appears to be considerable phenotypic diversity within the taxon, only three subspecies of cane have been identified, and these can be differentiated using a combination of morphological features (i.e., foliage and leaf morphology, branching, culm internodes, and culm diameter) and genetic information (Clark and Triplett 2007; Triplett et al. 2006; Walter 1788).

In most cases, however, species identification can only be achieved by examining complete, or nearly complete, fragments of cane culms/stems and branches (Horton 2010).

The three subspecies of cane identified include: giant cane (*Arundinaria gigantea*), switch cane (*Arundinaria tecta*), and a recently identified hybrid species referred to as hill cane (*Arundinaria appalchiana*) (Platt et al. 2009; Triplett et al. 2006; Triplett and Weakely 2006). Giant cane, commonly referred to as river cane, is the most robust of the three species. River cane has been reported to grow nearly 26 ft. in height, and is known to be the most widely dispersed species, occurring throughout the Southeast in the Mississippi River Valley, Appalachian Ozark Uplands, Gulf Coastal Plain, and in parts of Northern Florida. Switch cane is distinguishable from river cane because it is much shorter in height, growing no more than 6 ft. tall (Hitchcock 1950), with culms much smaller in diameter. Switch cane is also not as widely distributed as river cane, preferring more moist environments, such as those along sandy margins of streams, non-alluvial swamps, and in live oak woods. It is generally restricted to the Coastal Plain, from southern Maryland to Alabama and Mississippi (Hitchcock 1951; McClure 1973). Hill cane is described as morphologically intermediate between river cane and switch cane. It has been reported as growing along mountain streams, on shady hillsides, and in foothill regions away from the water. Hill cane is believed to be indigenous to the Appalachian Mountains, southern Blue Ridge, Blue Ridge Piedmont escarpment, upper Piedmont, and Ride and Valley physiographic provinces (Triplett et al. 2006). As a species, cane is known to spread very rapidly underground and has the ability to grow in extremely dense monoculture stands, traditionally referred to as "brakes" or "canebrakes" (Horton 2010:156).

While today canebrakes are regarded as critically endangered ecosystems (Noss et al. 1995), they were once a major component of the local flora throughout the Southeast

(Judziewicz et al. 1999). Bartram (1791) described portions of the landscape he encountered in Florida as “vast cane meadows”, an “endless wilderness of cane”, and as “widespread cane swamps”. Cane culms were frequently reported as being 10 to 12 meters tall, as “thick as a man’s arm”, and so dense that there was no way to penetrate them (Estes and Thompson 1984; Platt and Brantley 1997). Many of the larger canebrakes encountered on the prehistoric landscape would have been along rivers, streams, wet lowlands, the margins of swamps, and on natural levees in alluvial floodplains (Estes and Thompson 1984; Hitchcock 1950; Penfound 1952). In these environments canebrakes would have been subjected to moderate to intense natural disturbances at various times throughout the year (Platt and Brantley 1997) and may also have been subjected to anthropogenic processes, being thinned out or pruned (Hill 1997) to encourage future growth (Brantley and Platt 2001; Buttrick 1831; Featherstonehaugh 1844; Gagnon et al. 2007; Platt and Brantley 1997; Platt et al. 2001; Swanton 1911). Today, many canebrakes established as part of cane revitalization efforts are manually thinned (Figure 3.1) if they become too dense (Roger Cain personal communication 2016). Densely populated brakes are not only difficult to navigate, but the tightly packed culms receive differential sunlight, which can negatively affect the growth of the culms.

It has also been suggested that canebrakes may have been cleared through intentional burning. Hughes (1966:115) recommends at canebrakes be subjected to fire for pruning roughly every ten years to remove dead culms and stimulate new growth. Fire disturbances are thought to help encourage clonal growth in established stands by affecting the mature phase of the species (Gagnon and Platt 2008). The suggestion that brakes were cleared by burning, however, has received some criticism by scholars who argue that burning would have constituted the destruction of a key economic resource and the devastation of a habitat for many important

Figure 3.1: Roger Cain Manually Pruning a Cane Brake at the Cherokee Nation, OK.

subsistence resources (Horton 2010:513). Canebrakes are recognized as being important ecosystems for a variety of fauna and wildlife including birds, reptiles, and more than 23 different species of mammal (i.e., white tailed deer, wild turkey, and bear) (Brantley and Platt 2001:1178; Platt et al. 2001). With estimates as high as tens of thousands culms harvested a year, it is clear that Native Americans would have needed to manage brakes in such a way that they were not decimating the culm populations, but were actively encouraging growth and removing dead or unhealthy culms (Horton 2010; Platt et al. 2009).

Experiments burning river cane have also shown that it is difficult, and at times impossible, to ignite green cane (Jan Simek personal communication 2016). This is not Surprising given that cane culms can have a relatively high water content. Burning, therefore, may not have been an exceedingly destructive process, as only dead culms would have been at risk. Additionally, recent experiments burning canebrakes have shown that periodic fire treatments not only helped to increase culm density, but also had an effect on culm size. Zaczek et al. (2010:267) report that the burning of canebrakes resulted in new culms that were shorter in height and smaller in diameter. The authors have found that canebrakes benefit from intermittent fire treatments, and that this practice effectively reduced culm mortality and increased cover and growth in subsequent years after application. They concluded that fire would have been a valuable tool for managing large canebrakes and establishing new stands (Zaczek et al. 2010:268).

Unlike many other species of plant represented in the grass family, the stems/culms of cane are considered to be much woodier, but tend to be more durable and less resistant to tearing than wood (Estes and Thompson 1984:59). The outer stem, or culm, is described as a "varnished-like surface" that consists of a silica-wax cuticle which forms a thin layer over the silica-rich epidermis, making the stem light, somewhat flexible, and almost impervious to water (Moore 1960). Below the epidermis is the rind, which is made up two layers of densely packed vascular bundles and soft tissue (Estes and Thompson 1984:60) (Figure 3.2). It is only the flexible outer layer, consisting of the cuticle and epidermis that is desirable for weaving, which means that the inner rind and soft tissue must be removed before any weaving can occur. Unlike many plant resources utilized, cane is evergreen and can be harvested during any season for the production of various forms of material culture. When cane is found in the archaeological record it can take the form of formal artifacts, the remnants of basketry or matting, pieces of carbonized torches, or the byproducts of cane processing. In such a fragmented state, most of the morphological features distinguishing cane species are either not visible or they have been removed as the result of processing (Platt et al. 2001).

Among contemporary Southeastern Indians, including the Caddo, Chickasaw, Choctaw,

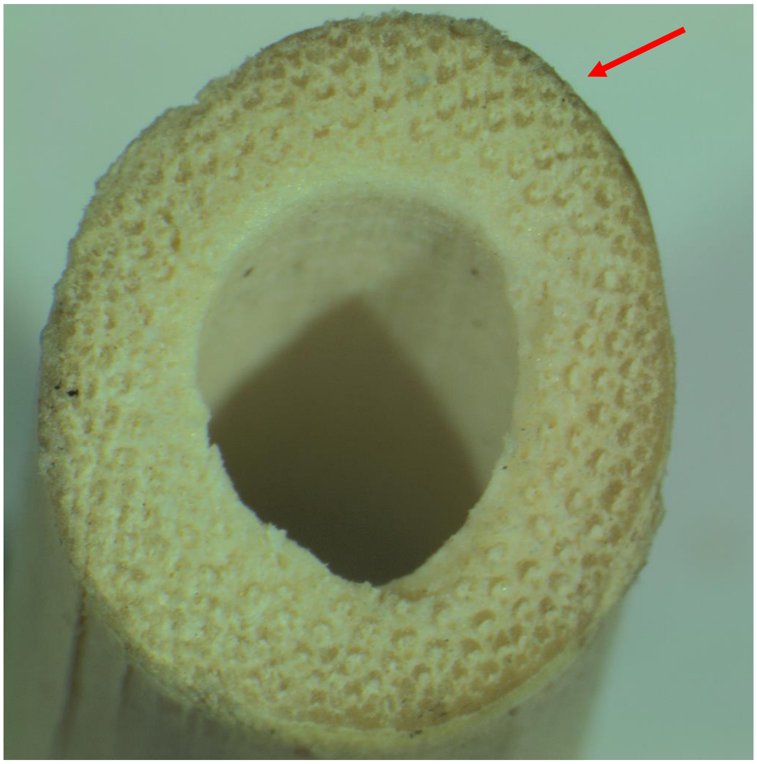


Figure 3.2: Cane Culm Showing Interior Vascular Bundles and Spongy Fibers. Arrow Points to Exterior Cuticle used in Split-cane Basketry

Chitimacha, Creeks, Catawba, Cherokee, and Seminoles, the use of cane is ubiquitous and well documented in the ethnographic record (Adair 1775; Hudson 1976; Mooney 1901; Swan 1855; Swanton 1918, 1946). In fact, one of the earliest written accounts referencing the use of cane is from the De Soto expedition (Hudson 1997). In nearly almost all ethnographic accounts, explorers, ethnographers, and later settlers report encountering dense canebrakes on the landscape throughout the Southeast. Among his travels throughout the Southeast Swanton (1911, 1941), among others, made several remarks about the use of cane by the different groups of people encountered. Among the Creeks, it was noted that "baskets for gathering, and fanning for cleaning corn, and other uses are made of cane splinters of various sizes…" (Swanton 1946:604). In his descriptions of the Natchez, Swanton (1911) makes several references to the use of cane as the raw material for mats that covered structures, beds, and seating, baskets used for food, ceremony, and storage, house construction and flooring. There are also several references suggesting that cane was sometimes utilized as a food source.

Although cane is known to flower only periodically, when it does, it produces an abundance of seeds that are described as being easy to gather and were recorded as being eaten by Native populations in several historical accounts (Brickell 1737; Flint 1828). Cane seeds were known to have been ground into flour and baked as a bread or mixed with water to produce a type of gruel. The seeds would have provided additional nutrition for hunter-gatherers as they exploited the resource for non-subsistence purposes. It is also hypothesized that the culms and leaves could also have been eaten. The culms are presumed to have been either eaten raw, or boiled or steamed to soften (Cheatham et al. 1995). It is likely that only young schutes were consumed, as culms may become increasingly harder and more fibrous as they age.

Although cane is used for a variety of purposes (Table 3.1), it was explicitly referenced as one of the most important raw materials used in the manufacture of basketry by Southeastern Indians. Mark Catesby, in *The Natural History of Carolina, Florida, and Bahama Islands (1731-1743),* noted:

> *The baskets made by the more southern Indians…are exceedingly neat and strong, is one of their masterpieces in mechanicks. These are made of cane in different forms and sizes, and beautifully dyed black and red with various figures; many of them are so close wrought that they will hold water, and are frequently used by the Indians for the purpose…*(in Speck 1920)

Although used by almost all cultures encountered in the region, there were observable differences in basketry weave, form, and style. Among the Creeks, for example, cane baskets were rarely dyed and they were traditionally restricted to four distinct shapes, identified as corn holders, sifters, trays, and utility baskets (Barnes 1984). Cherokee baskets, in contrast, were dyed using a range of colors and considerable variation was observed in basket form and size.

Table 3.1: Utilization of Cane (*Arundinaria* sp.) by Southeastern Indians (adapted from Swanton 1911, 1946 and Estes and Thompson 1984:60)

Construction	*Domestic Uses*
Timbers	Cradles
Roofing Mats	Knives
Backing for wattle	Combs
Fence Post	Pipes
Palisades	Musical Instruments
Fiber	Bedding
Drills	Mats
	Furniture
Hunting and Fishing	Boxes
Traps	Baggage
Spears	Flour
Arrows	Torches
Blowguns	Baskets/Vessels
Darts	
	Warfare
	Shields
Agriculture	
Corn cribs	
Sieves	
Fanners	
Winnows	

Many traditional Cherokee baskets were used as burden or storage baskets (Speck 1920; Swanton 1946), and other forms were manufactured to serve a variety of roles associated with food preparation (Sattler 1984; Swanton 1946).

Cane preparation is recorded as being quite demanding and is often described as one of the most challenging of all raw materials used by contemporary Cherokee weavers (Hill 1995). There are historic and contemporary descriptions of cane processing among many Southeastern tribes, and although details regarding specific tools and techniques vary considerably, the actual processing of cane differs very little. The following description by Swanton (1946:605) comes from an informant within the Lower Creek Nation:

> *They first selected cane about as large as one's finger or perhaps a bit larger and split them up into several pieces, after which they stripped the outside bark from each. This was known as stripping the cane and it was usually done in the canebrake itself, the stripped cane being afterward made into bundles and carried home.*

Having attempted to split, peel, and scrape cane for experimental purposes, I can personally attest to the fact that cane processing is difficult, tedious, and at times quite painful. As will be discussed in greater detail below, my experiences processing cane were not adequate if I wanted to understand not only how the process occurred, but what kinds of tools might be efficient for the task. Much of the information presented in this dissertation regrading split cane processing, is derived from observations and personal communications with expert basket weavers Roger and Shawn Morton Cain. Roger and Shawna are both members of the United Band of Keetoowah Indians in Oklahoma, Cherokee National Treasures, and professional cane weavers.

For most weavers, cane culms are selected based on their height, flexibility, internode distance, and age (Colvin 2006; Horton 2010), but culm selection would have differed depending upon the object of manufacture as well as cultural preferences. The process of preparing cane splits is extremely labor intensive, requiring a considerable amount of processing to achieve the desired culm width and thinness. Depending upon the size of the basket or mat being produced, a weaver might need to prepare as many as 120 individual splits (Hill 1997; Shawna Cain personal communication 2016). Colvin (2006:78) notes that "in the old days" Choctaw weavers would often construct shelters at or near cane brakes and stayed at these temporary camps for the duration of the cutting, splitting, stripping, and trimming of the culms. There are many other descriptions among historic weavers noting that cane culms were either processed immediately after being cut down, or they were soaked in water to stay soft and relatively pliable for future processing (Bockhoff 1977; Gregory 2006; Hill 1997; Leftwhich 1970; Swanton 1911; Whitford 1941). Contemporary weavers tend to process cane immediately after it is harvested to ensure that it is flexible enough to manipulate and not too brittle to the point where it splinters when processed (Shawna Morton Cain and Roger Cain personal communication 2016).

Before river cane can be used for weaving it must be split longitudinally several times (Figure 3.3) to create thin strips, or splits, and the waxy outer cuticle must be removed from the more porous interior rind (Figure 3.4). The cuticle and epidermis is must be peeled away from the soft rind tissues in order to make the culm malleable, and any fibers still adhering to the cuticle are removed through scraping, a processing traditionally referred as the thinning of the cane (Figure 3.5 and Figure 3.6) (Colvin 2006; Hill 1997; Shawna Morton Cain personal communication 2016). The process of scraping is a necessary step for weavers, as it results in the breakdown of the epidermis fibers and makes the splits more flexible. The amount of scraping needed, however, often depends on the size of the basket being woven, weaver skill level, and also preferncces. It was noted, for example, that in many instances splints can be woven into a basket or mat without having been extensively scraped or scraped at all (Shawna Morton Cain and Roger Cain personal communication 2016). At the end of the preparation process, the floor is

Figure 3.3: Splitting of Cane Culm using Pocket Knife

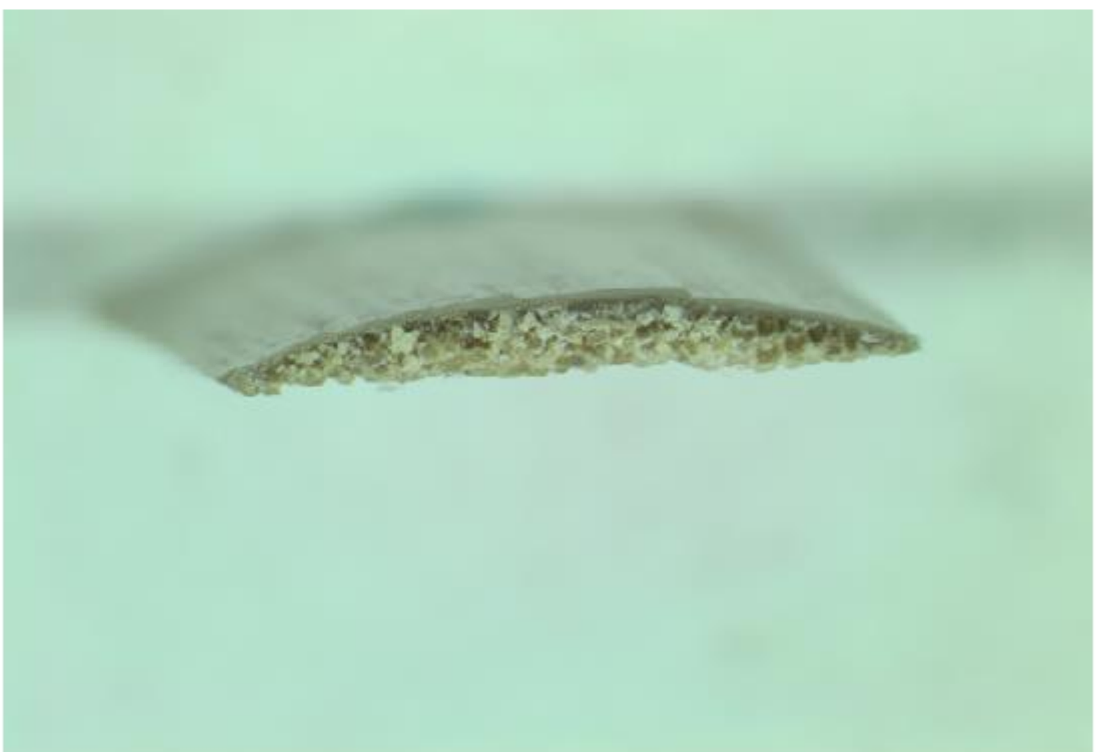


Figure 3.4: Processed Cane Split Consisting of Outer Vascular Layers and Silica-rich Cuticle.

Figure 3.5: Split-cane Processing: (Top) Thin Layer of Inner of Rind being Peeled Away from Cuticle; (Bottom) Thick Peel of Inner Rind Lacking Waxy Cuticle

Figure 3.6: By-products of Cane Processing Consisting of Peeled and Scraped Fragments of Inner Rind

littered with large strips of inner rind, small curled ribbons of scraped rind fibers, as well as splits in various states of preparation that had been rejected by the weaver for various reasons (refer to Figure 3.6). Contemporary weavers Shawn Morton Cain and Roger Cain explain that the cane by-products tend to be burned or swept up as trash. The fine culm shavings are known to make excellent kindling, and no doubt would have served this purpose among prehistoric societies.

Descriptions of the tools used in the actual processing of cane vary, and in most cases there are references to modern tools, such as sharp pocket knives, which are necessary to initiate the splitting, quartering, and peeling of culms (Colvin 2006; Hill 1997). There are also some references to tools which may be considered more traditional, or whose use pre-dated Europeans in the Southeast. Swanton (1931:40) made a note, for example, that among the Choctaw, cane was processed using a special knife that was made specifically for splitting and trimming. The Choctaw are also known to have used a cane splitter and knives made from the base of older cane stalks (Colvin 2006:78). Among the Chitimacha, Swanton (in Gregory 1984:44) recorded that after cane was cut, it was quartered by twisting and breaking it across the leg. It was also reported that the cortical surface of the culms was peeled into strips by “catching thin strips in the teeth”. This technique for processing cane is not well documented among other groups or among modern weavers, as cane splits can be extremely sharp and when brittle, cane can splinter and penetrate the skin causing small slivers (Shawna Morton Rain and Roger Cain personal communication 2016). The most efficient method for processing cane is with the aid of a sharp instrument.

3.2.3 Split-cane and Stone Tools

In order to fully investigate the efficiency of stone tools in the processing of river cane, and characterize the macro and microscopic wear patterns that developed during specific stages of use, it was necessary to conduct processing experiments. The stone tools selected for the experiments were unmodified flakes whose active edges were not modified or retouched in any way prior to use. Flake implements were selected over retouched bifacial tools not only because of the inherent sharpness of an unmodified edge, but also because as a class of tools, unretouched flakes are largely overlooked. Simple flake tools are not only suitable for a wide range of tasks, but they can be used with minimal, if any, retouch or cultural modification and they would have been readily available to prehistoric weavers throughout the Southeast. As mentioned in Chapter 2, unmodified or minimally retouched flakes are also often associated with women's technology among many historic and contemporary stone using cultures.

In this section I describe the cane processing experiments that were conducted for this dissertation. Information detailing the results of the microwear analysis on the experimental tools used will be presented in Chapter 6. A set of preliminary experiments were conducted for this dissertation by myself, based on descriptions of cane processing found in Hill (1995) and Colvin (2006). While these initial experiments were informative, it was apparent that my skill level and experience with river cane was hindering the experiments and ultimately affecting use-related wear patterns. It became clear that the most effective way to replicate realistic use contexts of river cane and stone tools was to incorporate an ethnoarchaeological perspective, wherein the individuals using the tools were performing tasks in which they were highly skilled and experienced.

Within the Eastern Band of Cherokee Indians, the United Keetoowah Band of Cherokee in Oklahoma, and the Cherokee Nation there are less than a dozen individuals who possess the knowledge and skills to harvest cane and process the culms into pliable weaving splints. Unfortunately because river cane is such a difficult plant to process with modern tools, I had great difficulty convincing weavers to abandon their steel blades for simple expedient flakes. That is, until I was fortunate enough to meet Roger and Shawna Morton Cain. Each have been awarded the honor of National Treasure within the Cherokee Nation for their contributions towards the preservation and revival of Cherokee art forms. Not only were they up to the challenge, but they had often spent time discussing the ways in which their ancestors would have manufactured split-cane baskets. Although eager, I did learn later that they were quite skeptical that the simple flake tools they would be using could be as efficient as a steel blade.

When the Cain's manufacture a split-cane basket, they work as a team. Both are knowledgeable and participate in all aspects of harvesting and processing of river cane, with each tending toward skill sets that complement each another in accomplishing this ancient work. Roger, whose depth of knowledge regarding cane is remarkable, typically harvests the culms. He tends to select individuals based on age and relative condition, preferring those that are at least 3-5 years or older. Roger notes that when preparing to harvest cane he pays close attention to the cycles of moon, as cane retains moisture much like wood. The moisture content of the cane often determines if the culms will be processed immediately or several months after they are harvested. In addition to harvesting the cane, Roger traditionally splits the culms with a bamboo splitter followed by quartering and peeling the culms to the desired size. After the initial splitting and peeling of river cane, the splits may be subjected to additional rounds of peeling in order to obtain the desired thickness for weaving. If desired thickness cannot be achieved with peeling, the splits will be thoroughly scraped to remove and breakdown the existing fibers. From start to finish, a basket my take up to a year for the Cain's to complete, when they factor in the process of dying the individual splints. Roger and Shawna utilize only natural dyes, harvesting blood root in late April and early May, and black walnut bark, leaves, and nuts, in May through

October. The prepared splints may soak in the dyes for several days up to several months, depending upon the color they are trying to achieve (King et al. 2016).

In July of 2016 I travelled to Tahlequah, Oklahoma to work with Roger and Shawna, bringing with me 40 unmodified flakes detached from five different varieties of fine grained chert. The flakes differed in size and shape, offering a variety forms to select from. Because our time together was limited, the culms harvested for the experiments were done so using modern tools. The initial quartering of the culms into four even pieces was accomplished with a bamboo splitter. The flake tools were used to split quartered culms into thinner splits before they were peeled and scraped (Figure 3.7). The flakes preferred for use as tools were larger cortical backed implements with edge angles ranging between 50 and 70 degrees. With such edge angles, these tools proved to be efficient implements for both the peeling and the scraping of the culms, and because of the natural cortical backing, they could easily be grasped in the hand without the need of a haft. Because of their skill level, Roger and Shawna were able to use flakes quite efficiently to separate the cuticle from interior fibers during the peeling process (Figure 3.8). A single flake implement was utilized in the peeling of nearly 120 individual splints without having to replace a flake because of a dulled edge. The experiments demonstrated that the flake tools were extremely efficient in all aspects of cane processing, and in some instances the flake tools were more efficient than modern steel blades. The results of the microwear analysis on the experimental flake tools will be discussed in Chapter 6.

3.2.4 Split-cane in the Archaeological Record

Although split-cane technology is believed to represent an ancient tradition spanning thousands of years, it is still unclear where and when this technology originated. Preserved fragments and impressions of cane matting and baskets reported in the archaeological record

Figure 3.7: Roger Cain Splitting Quartered Culm with a Flake Tool

Figure 3.8: Shawna Morton Cain Peeling Cane Split with a Flake Tool

throughout the Southeast suggest that split-cane technology was in use by at least the Late Archaic, 2,500 years ago (Horton 2010). The earliest example of cane recorded in the archaeological record is that of a single specimen of plaited matting reported by Wilson (1889:674) from Petit Anse Island, Louisiana. The specimen was reported to have been recovered two feet below the tusks and bones of a Pleistocene elephant, and was described as simple twill plaiting made from the outer bark of cane. The antiquity of the sample, however, has been called into question (Andrews and Adovasio 1993) and no radiocarbon dates have been reported.

The oldest well-dated fragment of split-cane technology found in the Southeast comes from Avery Island, Louisiana. The basket fragment, which was discovered in the 1860's (Ford and Webb 1956; Neuman 2006), dated to 2310 ± 590 years B.C., or roughly 4000 B.P. (Gagliano 1970; Neuman 2006:6; Kuttruff and Kuttruff 1996). While this is the oldest securely dated piece of split-cane technology in the Southeast, cane culms were being used as torches in caves at roughly the same time. When found as torch material, culms tend to be bundled together tightly or remnants of cane charcoal appear as smudges on cave walls (Watson and Yarnell 1966). Radiocarbon dates on cane charcoal from Lee Cave in Kentucky, for example, date to as early as 4200 ± 65 years B.P. (Crothers et al. 2002), however earlier torch fragments have been recovered from cave sites in the Southeastern United States (Frankin 2002). Although radiocarbon dated to somewhat later, 2630 ± 44 years B.P., remnants of cane baskets were also recovered from Mammoth Cave, Kentucky.

Additional specimens of cane matting and baskets, as well as non-basketry objects manufactured from cane culms, were recovered from multiple Ozark Bluffshelter sites. In fact, Horton (2010) found that cane represents one of the predominant sources for basket/fiber technology in the Ozarks. In her survey and analysis of perishable industries from several Ozark Bluffshelters, Horton (2010:) found that while there is evidence for cane basketry in this region during the Late Archaic, it becomes dominant and widespread in the Ozarks by the Middle Woodland about 1,700 years ago (Table 3.2). Baskets, cane matting, and trays are recovered from a wide variety of contexts within the Bluffshelters. At several sites, cane baskets, mats, and trays are interred within human burials, are found as caches, and some instances baskets were recovered still filled with remnants of edible seeds (Fritz 1994; Harrington 1960; Horton 2010). By carefully analyzing basket specimens and fragments, and documenting specific weave techniques and patterns, Horton demonstrated that that there was continuity in certain aspects of construction, as well as an elaboration of decorative motifs and a refinement in split-cane baskets from the Middle Woodland to the Mississippian (Horton 2010:79-80).

3.3 Women and Perishable Material Culture

For generations, women within many cultures were responsible for transforming plant fibers into perishable material culture and food stuffs. The association between women and children and perishable technology has been firmly established cross-culturally, and there is ample evidence to suggest that within many prehistoric societies perishable technology falls within the realm of women’s work (Adovasio et al. 2007; Kent 1983; King 1991; Mason 1970; Soffer et al. 1998). Although studies on the division of labor by sex have shown that men and women can both be responsible for the production of textiles, basketry, and cordage, this tends to occur most frequently within market economies where perishable technologies serve important roles within the economic system (Murdock 1937; Murdock and Provost 1973). As previously mentioned, men’s participation in basket making tends to increase in contexts where baskets become important items of trade. Today, while many women continue to weave baskets,

Table 3.2: Dates for Split-Cane Technology from Ozark Highland Bluffshelters

Shelter	Accession Number	Lab #	Uncalibrated rcybp	2 Sigma calibration	Method
Indian Bluff (3BE9)	32-24-33	OS-71600	2230 ± 35	387 - 203 B.C.	Direct
Alfred Bluff South (3Be240)	32-142-1	OS-71611	1790±20	AD 137-259	Direct
Indian Bluff (3BE9)	32-24-2	OS-71603	1460±25	AD 560-646	Direct
Beaver Pond Shelter (3CWII)	32-2-647	OS-71612	1010±30	AD 974-1079	Direct
Fitch Shelter (3MA7)	32-89-7	OS-71602	990±30	AD 989-1153	Direct
Montgomery Shelter (23BY)	32-34-58A	OS-71601	560±25	AD 1312-1425	Direct
Cob Cave (3NW6)	31-15-26	Beta 244400	480±40	AD 1394-1475	Direct
Beech Creek Shelter (3NW637)	87-155-4	AA-9768	1370±50	AD 580 -770	Associated
Marble Bluff (3SE1)	34-23-341	SMU-1682	2926±40	1263-1009 B.C.	Associated
Marble Bluff (3SE1)	34-23-327	SMU-1681	2843±44	1189-898 B.C.	Associated

(Table after Horton 2010:263)

men are often observed participating in aspects of the weaving process, or weaving baskets themselves (Personal communication with Roger and Shawna Morton Cain).

In prehistoric North America, women are generally regarded to be the primary weavers and producers of basketry, and this relationships has been documented by early explorers, missionaries, ethnographers, and informants. George Wharton James (1903:15) noted in his studies of Native American basketry that, "One of the foremost of the industrial arts is that of weaving – purely a product of women's wit and skill". He goes on further to say:

> *The thought of the woman, the art development, the acquirement of skill, the appreciation of color, the utilization of crude materials for her purpose, the labor of gathering the materials, the objects she had in view in the manufacture of her baskets, the methods she followed to attain those objects, her failures, her successes, her conception of art…the aesthetic qualities of mind that led to decide to thus reproduce of imitate nature – all these, and a thousand other things in the Indian woman's life, are discoverable in an intelligent study of Indian basketry.*

James (1904) also recognized that women's knowledge of plant resources and their locations on the landscape would likely have played an important role in determining settlement locations and movement on the landscape throughout the year. As the dependence on plants as a food source and raw material intensified, women's depth of knowledge of the local landscape and plant resources would have been vital for both economic and subsistence success (Anderson 2005:42).

Among the many tribes in California, there is not only a strong association between women and fiber technologies, but indigenous women in California have been described as "the world's best basket makers" (Mason 1901:155). Basketry in societies such as the Karuk, conveyed social information, expressed aspects of a woman's identity, and could ultimately determine a woman's place within her society (Anderson 2005:188). Devon Abbot Mihesuah has stressed the importance that basketry played in the lives of Native American women throughout California, explaining that basketry was one of the most important ways for a woman to "contribute economically, demonstrate skill, gain esteem, and express artistic vision" (2003:85). Studies of coiled basket technology among historic groups, like the Pomo, Yurok, Pima, and Navajo, also found that women were the primary producers of basketry and were responsible for the vast majority of the gathering and processing of the plant materials (Newman 1974). Among the Pomo, men were recorded as helping women with some of the coarser work, but for the most part, women were responsible for the harvesting and processing activities. They were observed using large knives to gather materials, and smaller knives and pieces of broken glass for fine processing and finishing work (Newman 1974:12).

Contemporary basket maker Julia Parker is known as one of the greatest baskets weavers within the Coast Miwok and Kashaya Pomo tribes. She has worked her entire life to continue the basket weaving tradition of her elders and ancestors, and makes it a priority to pass down these ancient traditions to younger generations (Valoma 2013). Parker not only continues to use traditional raw materials in her baskets, but she utilizes only traditional tools and maintains a strict gender ideology associated within this practice. When describing the tools utilized in the processing of baskets materials, Parker (in Valoma 2013:217) explains:

> *The elders told us, 'don't let the men touch your work', we don't touch their tools, because they take life. And we give life, so we don't touch their bows and arrows. No, we ladies don't make spears or anything that takes life, because we give life. Men are the hunters. They are the ones that make obsidian tools. Now, this obsidian that I have in my hand, I can touch this. A man started to make an arrowhead, but it broke, so he gave it to me. And I can use it for scraping and for cutting….But the men make the tools we use….we each have our own tools…we also work on our own baskets. We don't let anyone touch our basket, or work on our basket. It is your work, and you're not supposed to let anybody touch it.*

Julia Parker continues to use obsidian tools in her processing of plant materials like dogbane, willow, and sedge, preferring to use what she considers to be traditional technology over modern tools.

3.3.1 Women and Split-cane Technology in the Southeast

In the Southeast, river cane represents one of the most important of all raw materials, and within many Southeastern tribes, women's association with this technology was noted by some of the earliest travelers and later ethnographers interested in split-cane technology. Cora Bremer, a journalist studying a group of Choctaw in the late 19th century, noted that cane harvesting was a year round endeavor that was primarily the responsibility of older women (1907:5). Bremer also described women's manufacture of cane baskets as more of an art form than a craft, because of the intricate designs and techniques employed. She noted that although baskets were heavily traded and produced for sale in the market, intricately decorated baskets were still used by Choctaw women for more utilitarian purposes in their day to day lives. Adair (1775:454-457) described cane baskets of the Cherokee as the "handsomest baskets" he had ever seen, and astutely observed that women were the “chief, if not *only* manufacturers” of this technology. In his *Observations on the Creek and Cherokee Indians*, Bartram (1853:326) also noted that women “turn their attention to various manual employments”, manufacturing all pottery and woven items.

Among the Cherokee the association with women and basketry is also recorded in folklore and early mythology as playing an important role in the lives of Cherokee ancestors (Mooney 1900). The story of the “First Fire”, for example, honors a female spider’s ability to weave a container to hold the fire that essentially brings the world out of darkness (Hill 2006, 1997; Mooney 1900). Selu, the ancestral mother to the Cherokee, is also closely linked to basketry, and Selu’s association with corn and craft provided the Cherokee with an explanation for gendered activities and divisions of labor between men and women (Perdue 1998). Sarah Hill (1997) has described women’s association with split-cane technology as “one of the most enduring aspects of Cherokee culture” (Hill 1997:38), and this relationship with cane is also apparent within other tribes throughout the Southeast.

It is only after sustained contact with Europeans, that fundamental shifts in split-cane technology and basketry technology as a whole are suspected to occur throughout North America. By the time of removal, Cherokee baskets become a vital economic resource and they are manufactured to be sold and bartered for other goods. As the economic importance of cane baskets grew, men and young boys were observed assisting female relatives in the gathering and processing of raw materials (Duggan and Riggs 1991:44). Despite the help of men, cane basketry among the Cherokee remained a female-centered technology through removal (Duggan and Riggs 1991; Hill 1995; Perdue 1998; Sattler 1984). While men do assist in many of the processing activities, the act of weaving remained almost exclusively the responsibility of women. This relationship is often still observed today, and a prime example is that of Roger and Shawna Cain. Both individuals participate in the full range of cane processing activities, but it is Shawna who physically manipulates the splits and weaves the baskets. Among Chitamacha, and Mississippi Choctaw, baskets also became important market items, and in many instances weavers began incorporating features of basket traditions made by Europeans into their containers (Hill 1995). This does not seem to be the case, however, among the Oklahoma Choctaw, as they never managed to develop a significant market economy for cane basketry because of their relative isolation on the landscape (Colvin 2006).

At present, river cane and split-cane technology remain essential parts of the material culture for many Southeastern Indians, despite the relative scarcity of river cane throughout the region. Although not well documented, canebrakes began to decrease and almost disappear following the rapid settlement of Europeans in the Southeast (Brantley and Platt 2001). The rapid loss of canebrakes is believed to have been the result of domesticated grazing animals, agricultural land clearing, flood control projects, and intense burning regimes (Brantley and Platt 2001; Platt et al. 2009). In 2011 the Cherokee Nation designated river cane as a culturally protected species on tribal land and started the Cherokee Rivercane Initiative for conservation and education efforts. Similar restoration programs, and studies of cane growth patterns and physiology (i.e., Bugden et al. 2011; Cirtain et al. 2009; Mills et al. 2011) have been established by conservationists and Native Americans throughout the Southeast (Brantley and Platt 2001; Personal Communication with Roger Cain). Because of conservation efforts, split-cane basketry is making a resurgence within many Southeastern communities, and thus remains the oldest continuous material tradition for groups like the Cherokee (Bloom 1945; Duggan and Riggs 1991).

It is evident that split-cane technology has deep roots in the Southeastern United States, and that it evolves over time to suit changing economic and social circumstances (Duggan and Riggs 1991). Split-cane technology first appears in the Southeastern archaeological record during the Late Archaic when there is a relative increase in the exploitation of edible seeds, and this technology appears to become ubiquitous in the region during the Woodland and Mississippian periods when seed exploitation transitions from small-scale to full-blown agriculture. It has been suggested (Geib and Jolie 2008) that in many parts of North America, especially the Southwest, that the development of basketry coincided with an increase in small seed exploitation and processing, and was moreover a fundamental component in this shift in subsistence practices. While Geib and Jolie (2008) focus primarily on the role of coiled basketry in the winnowing and parching of seeds, plaited split-cane baskets could have served the same role in the Southeast, and moreover could also have been essential for other types of gathering and processing activities, such as those associated with shellfishing. In the next Chapter I introduce the Mussel Beach site, provide details regarding the most recent excavations and summaries of previous artifact analyses and interpretations.

Chapter 4: The Mussel Beach Site: Background and Previous Analyses

The archaeological site selected for this study is the Mussel Beach site (40MI70) in Marion County, Tennessee (Figure 4.1). Previous archaeological investigations at Mussel Beach have revealed a dense occupational history that extends from the Late Archaic through the Late Woodland. Evidence from faunal assemblages, ceramics, paleobotanicals, and lithics demonstrate changes in site use over time. The relative shift in site use from a hunting and raw material procurement camp, to a shellfish collection camp, and long-term winter habitation with evidence of a garden economy, suggests changes in population demographics and divisions of labor among site occupants. Having only been partially analyzed by New South Associates, the lithic assemblage from Mussel Beach offers an opportunity to further explore the ways in which stone tools contributed to material culture production by gendered individuals.

4.1 Mussel Beach Site Background (40MI70)

The Mussel Beach is located on the southern bank of the Tennessee River within the Sequatchie Valley, just below the Nickajack Dam (Gregory et al. 2011). This physiographic region is rich in an array of natural resources and lithic raw materials, including formations of Fort Payne, Knox, and Bangor cherts as well as lower quality quartz and quartzite (Gregory et al. 2011). Located on a fertile river terrace within the Appalachian Oak Forest, the landscape surrounding 40MI70 would have contained a mixed hardwood forest and a wide variety of naturally occurring fruits, herbs, grasses, and wild cultigens.

4.1.1 Excavation History

Site 40MI70 was originally recorded in 1976 during an archaeological survey for the TVA barge terminal at the Nickajack Port. The initial survery, which did not include hand or machine-assisted excavations, attempted to define site boundaires through surface scatter. Based

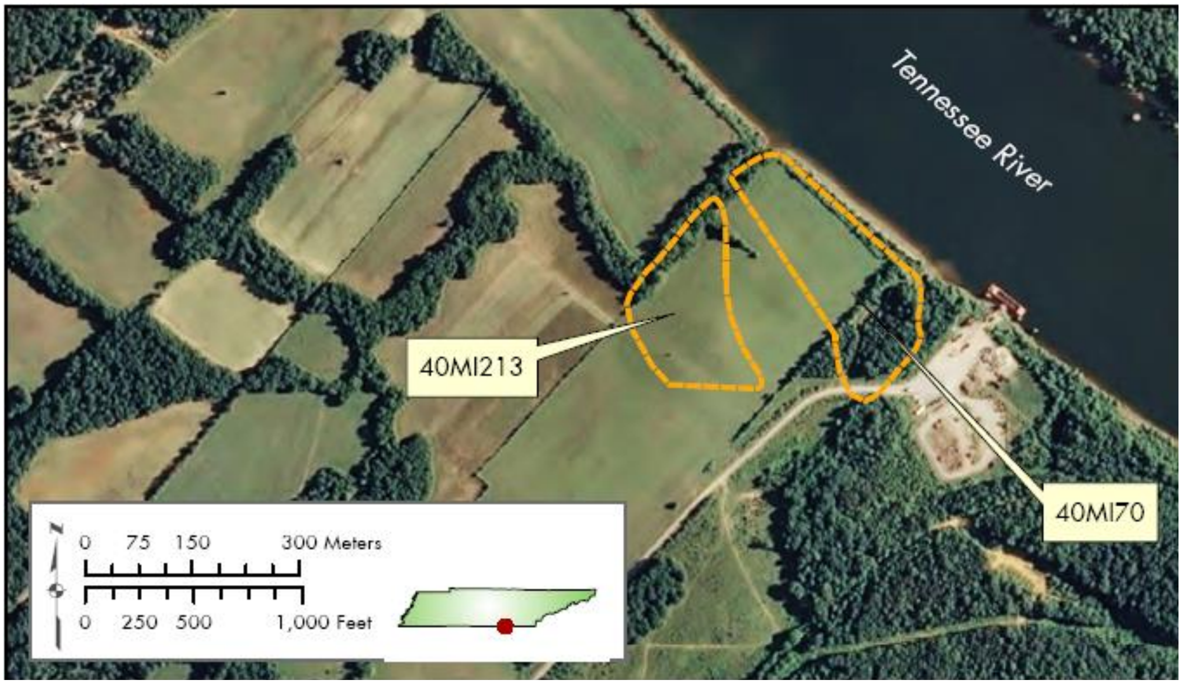


Figure 4.1: Arial Map Showing the Location of 40MI70. (From Gregory et al. 2011:3).

on the initial findings, Mussel Beach was described as a "riverbank shell midden with sparse pottery" and lithic scatters (Polhemus 1976:7). In 1981 the first subsurface testing of site 40MI70 was conducted. This testing consisted of a single hand excavated 1x1 meter test unit accompanied by three machine-excavated test units (Hubbert 1981 cited in Gregory et al. 2011).

Although the 1981 excavations encountered dense layers of shell midden, no further excavations were conducted at Mussel Beach until 1991. The 1991 excavations consisted of the machine excavation of several trenches and the hand excavation of a single test unit. Diagnostic artifacts recovered during these excavations confirmed the presence of intact Late Archaic, Early Woodland, and Middle Woodland occupations, as well as the presence of additional stratified shell middens and shell-filled features, however no absolute dates were obtained (Alexander 1991; Gregory et al. 2011:15; Soils and Futato 1987). In 2000 TVA officials conducted additional testing at Mussel Beach and identified a prehistoric human burial within a dense shell midden. The midden context was located outside of the Area of Potential Effects (APE), and information related to this burial is not currently available.

Additional data recovery efforts were conducted at Mussel Beach in 2008 for CB&I (Alexander and Redwine 2008). The 2008 survey consisted of systematic shovel tests that resulted in the refinement of the site's stratigraphy and the establishment of the boundary of cultural deposits. The results of the survey also led to the determination that the Mussel Beach site was eligible for National Register of Historic Places because of its potential to contribute to the prehistory of the Sequatchie Valley and surrounding area (Alexander and Redwine 2008; Gregory et al. 2011:4).

Following the 2008 archaeological survey, CB&I proposed the construction of a fabrication facility, and associated structures, which threatened to destroy the cultural deposits at the Mussel Beach Site. To mitigate the destruction, New South Associates began excavations and data recovery efforts during the summer of 2009 that included the mechanical excavation of eight trenches (Trenches 1-8) and the excavation of two 50-cm-x-50 cm control units (Units 1-2). In October of 2008, New South Associates began Phase III excavations under the supervision of CB&I and TVA with the goals of identifying previous excavation units, the site entire site boundary, and to recover additional data about the prehistory of the Sequatchie Valley (Gregory et al.:5).

The 2009 excavations consisted of a multi-stage program of geophysical prospection, hand excavation, and machine-assisted excavations (Gregory et al. 2011). Fieldwork included the hand excavation of 92 1x1 meter test units, 23 backhoe-excavated trenches, and 2,543 square meters of machine-assisted stripping (Figure 4.2) (Gregory et al. 2011). Investigations at the site

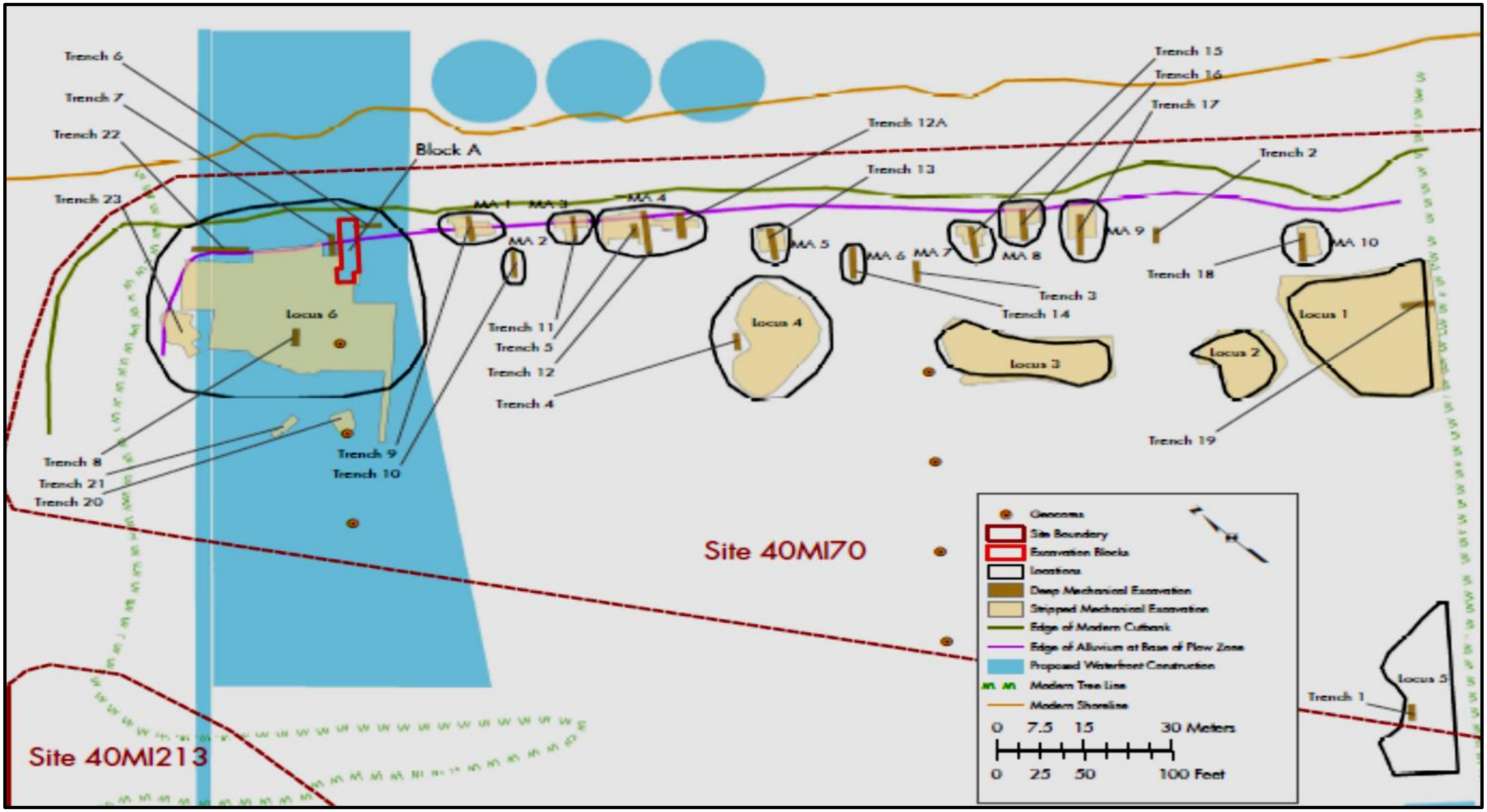


Figure 4.2: Plan View of Initial Excavation Area Including Trenches, Midden Areas, and Features. (Image courtesy of Gregory et al. 2011)

and the excavation of 189 radar anomalies and 108 cultural features, revealed deeply stratified deposits with five primary cultural components. No human remains, with the exception of a single tooth, were encountered within the designated areas of excavation.

4.1.2 Excavation Results

The excavations conducted by New South Associates resulted in the identification of five primary temporal components: three Late Archaic (Late Archaic I, II, and III), one Middle Woodland (MW) component, and one Late Woodland (LW) (Table 4.1) (Gregory et al. 2011:4). The occupations were firmly dated between 5,480 and 910 B.P and the chronology was defined through sediment stratigraphy, temporally diagnostic artifacts, and 18 standard radiometric and 19 AMS dates (Table 4.2) provided by Beta Analytic, Inc. (Gregory et al. 2011:124).

The oldest of the occupations, referred to Late Archaic I (LA I), was identified by New South as a singular lithic reduction area used as a temporary campsite for the early stage lithic reduction (Gregory et al. 2011). The Late Archaic II (LA II) component has been interpreted as a reused logistical camp occupied primarily in the fall for the purpose of hunting, as well the gathering of seeds and processing of nuts for storage. It contained several thermal features, a large collection of seeds of local fruits, herbs, and grasses, as well as a few cultigens (Gregory et al. 2011:5). The final Late Archaic III (LA III) occupation was interpreted as logistical campsite that was reused seasonally over a 600-year period. Gregory et al. (2011) do note that the Late Archaic III component likely reflects a Late Archaic/Early Woodland transitional phase. The components contains a mix of diagnostic lithic artifacts and ceramics which fit into both the Late Archaic and Early Woodland temporal components.

The final components identified at the Mussel Beach site contained the Middle and Late Woodland occupations. The Middle Woodland (MW) at Mussel Beach was the densest

Table 4.1: Summary of Calibrated Dates for Each Temporal Component at Mussel Beach Site

Component	Age (yrs B.P.)	Dating Method	Strata	Site Type
Late Archaic I	4,850–5,480	AMS	V, Va	Lithic Reduction
Late Archaic II	3,890–4,700	Relative, C14, AMS	Iva, Ivb	Reused campsite
Late Archaic III	2,340– 2,940	Relative, C14, AMS	IV	Reused campsite
Middle Woodland	1,230 - 2,170	Relative, C14, AMS	IIIb, IIIc	Village/Hamlet
Late Woodland	910–1,260	Relative, C14, AMS	IIId	Campsite

(Table from Gregory et al. 2011)

component showing evidence of multiple short-term logistical occupations and a longer, more substantial, habitation (Gregory et al. 2011). Radiocarbon and AMS dates revealed two distinct temporal clusters within the Middle Woodland component. The earliest cluster has been interpreted as a logistical camp occupied primarily for the exploitation and bulk processing of shellfish. The later occupation contained an intensive winter camp, as evidenced the remnants of structure, a large refuse midden, and several domestic features including earth ovens and storage pits. It also contained one of the largest assemblages of lithics, faunal, and floral specimens found at the site and a wide variety of cultural features, including shell-filled pits and smudge pits, shell-processing and refuse middens, thermal pits, and post holes and burned posts (Gregory et al. 2011).

4.2 Previous Analysis of Artifact Assemblages:

The lithic, ceramic, faunal, and paleobotanical assemblages recovered during the 2010 mitigation were analyzed by New South Associates. The results of New South's analyses are

Table 4.2: Radiocarbon Dates Obtained from Features at Site 40MI70

Beta Sample No.	Analysis Type	Material	Context	Temporal Component	Conventional Date	Weighted Mean	1-signma	2-sigma
Beta-281378	AMS	Charcoal	Unit 13	Late Archaic I	4680 ± 40	5416 ± 70	5467 − 5323	5577 − 5313
Beta-281379	AMS	Charcoal	Unit 1	Late Archaic I	4360 ± 40	4935 ± 61	4965 − 4865	5040 − 4849
Beta-280286	AMS	Charcoal	Feature 424	Late Archaic II	3760 ± 40	4123 ± 72	4226 − 4009	4242 − 3985
Beta-280189	AMS	Charcoal	Feature 496	Late Archaic II	3790 ± 40	4174 ± 74	4236 − 4094	4351 − 3994
Beta-281223	C14	Charcoal	Feature 423	Late Archaic II	3990 ± 60	4466 ± 104	4569 − 4317	4786 − 4247
Beta-281224	AMS	Charcoal	Feature 456	Late Archaic II	2830 ± 40	2941 ± 59	2988 − 2872	3073 − 2846
Beta-281234	C14	Charcoal	Feature 483	Late Archaic II	4000 ± 80	4489 ±139	4782 − 4299	4814 − 4237
Beta-281375	AMS	Nutshell	Feature 413	Late Archaic II	3840 ± 40	4259 ± 78	4377 − 4155	4410 − 4104
Beta-280283	AMS	Charcoal	Feature 394	Late Archaic III	2780 ± 40	2879 ± 52	2946 − 2809	2968 − 2778
Beta-280285	C14	Charcoal	below Feature 383	Late Archaic III	2670 ± 80	2788 ± 101	2870 − 2730	2972 − 2496
Beta-281226	C14	Charcoal	Feature 472	Late Archaic III	2480 ± 40	2564 ± 96	2707 − 2487	27919 − 2365
Beta-281222	AMS	Charcoal	Feature 406	Late Archaic III	2420 ± 40	2491 ± 106	2669 − 2356	2701 − 2348
Beta-280288	AMS	Charcoal	Feature 484	Middle Woodland	2400 ± 40	2504 ± 107	2675 − 2359	2702 − 2351
Beta-280287	AMS	Charcoal	Feature 248	Late Archaic III	2430 ± 40	2466 ± 100	2471 − 2350	2698 − 2342
Beta-281221	C14	Charcoal	Feature 392	Middle Woodland	2050 ± 80	2032 ± 108	2120 − 1925	2304 − 1825
Beta-283763	AMS	Charcoal	Feature 42	Middle Woodland	1970 ± 40	1922 ± 45	1984 − 1878	1928 − 1727
Beta-280280	AMS	Charcoal	Feature 395	Middle Woodland	1900 ± 40	1839 ± 52	1898 − 1747	1945 − 1735

Table 4.2 (Cont.): Radiocarbon Dates Obtained from Features at Site 40MI70

Beta Sample No.	Analysis Type	Material	Context	Temporal Component	Conventional Date	Weighted Mean	1-signma	2-sigma
Beta-283764	AMS	Charcoal	Feature 43	Middle Woodland	1910 ± 40	1852 ± 51	1919 − 1819	1816 − 1570
Beta-280282	AMS	Charcoal	Feature 340	Middle Woodland	1770 ± 40	1687 ± 62	1735 − 1613	1775 − 1342
Beta-280279	C14	Charcoal	Feature 350	Middle Woodland	1640 ± 90	1546 ± 106	2852 − 2494	2927 − 2360
Beta-280284	C14	Charcoal	Feature 383	Middle Woodland	2610 ± 110	2675 ± 153	1314 − 1262	1346 − 1181
Beta-259873	AMS	Charcoal	Feature 254	Middle Woodland	1360 ± 40	1280 ± 37	1311 − 1185	1349 − 1175
Beta-283759	C14	Charcoal	Feature 462	Middle Woodland	1350 ± 50	1265 ± 48	1347 − 1296	1386 − 1284
Beta-281227	C14	Charcoal	Feature 439	Middle Woodland	1420 ± 40	1328 ± 28	1318 − 1269	1352 − 1183
Beta-281228	C14	Charcoal	Feature 438	Middle Woodland	1370 ± 40	1334 ± 29	1351 − 1299	1392 − 1288
Beta-281229	C14	Charcoal	Feature 432	Middle Woodland	1430 ± 40	1370 ± 44	1401 − 1330	1509 − 1299
Beta-281320	C14	Charcoal	Feature 435	Middle Woodland	1480 ± 40	1580 ± 59	1685 − 1528	1697 − 1420
Beta-281230	C14	Charcoal	Feature 430	Middle Woodland	1670 ± 40	1361 ± 47	1385 − 1307	1378 − 1262
Beta-281231	C14	Charcoal	Feature 461	Middle Woodland	1460 ± 50	1309 ± 29	1334 − 1285	1692 − 1382
Beta-281232	C14	Charcoal	Feature 436	Middle Woodland	1390 ± 40	1511 ± 76	1561 − 1415	1393 − 1178
Beta-281233	C14	Charcoal	Feature 441	Middle Woodland	1620 ± 60	1295 ± 56	1352 − 1262	1393 − 1065
Beta-283761	C14	Charcoal	Feature 494	Middle Woodland	1380 ± 60	1234 ± 81	1318 − 1173	1378 − 1065
Beta-283760	C14	Charcoal	Feature 258	Middle Woodland	1330 ± 80	1011 ± 45	1055 − 964	1122 − 929
Beta-281377	AMS	Charcoal	Feature 262	Late Woodland	1200 ± 40	1197 ± 55	1271 − 1172	1283 − 1080

Table 4.2 (Cont.): Radiocarbon Dates Obtained from Features at Site 40MI70

Beta Sample No.	Analysis Type	Material	Context	Temporal Component	Conventional Date	Weighted Mean	1-signma	2-sigma
Beta-281225	AMS	Charcoal	Feature 256	Late Woodland	1200 ± 40	1197 ± 55	1271 − 1172	1283 − 1080
Beta-280281	AMS	Charcoal	Feature 378	Late Woodland	1030 ± 40	887 ± 53	956 − 802	965 − 794

(Table after Gregory et al. 2011:456 and Carmody 2014:92-93) presented below, beginning with the ceramic assemblage, and followed by the paleobotanical, faunal, and lithic assemblages. Information obtained from more recent analyses of the plant remains is also included, as are preliminary results of an analysis of the shell tools recovered from the site. The information presented in this section on the lithic artifacts, however, does not include any of the results of the most recent analyses conducted for this dissertation.

4.2.1 Ceramic Analysis

The analysis of the ceramic assemblage (N = 3,118) from Mussel Beach (40MI70) was conducted by Chris Espenshade and Bryan Tucker (Gregory et al. 2011:391). A specialized vessel-based analysis was conducted on the ceramic artifact assemblage. Vessel-based analyses were selected because they are believed to offer the following advantages over traditional sherd-based studies: 1.) Data are not skewed by differential breakage rates or differences in vessel size; 2.) vessel counts provide data for the modeling of site use span and understanding and documenting depositional patterns; and finally; 3.) vessel-based analyses are believed to be well suited to address questions of technological choice and tradition (Gregory et al. 2011:392). Attributes measured on all identifiable sherds included surface decoration, aplastic type, general thickness, interior surface treatment, paste, and color. Surface treatments identified among the ceramic vessels at Mussel Beach were plain, fabric-impressed, check-stamped, complicated stamped, zone punctuated, and incised (Gregory et al. 2011:393). Sherds with attributes that were internally consistent were grouped together as a sample vessel (Gregory et al. 2011:392). Between all temporal components total of 62 sample vessels (Table 4.3) were identified, however this does not represent an absolute minimum vessels because not all sherds could be identified as belonging to a vessel. The vessels recovered from dated contexts helped in defining temporal units (Figure 4.4), as there were clear changes in both temper and surface decoration

Table 4.3: Summary of Identified Ceramic Vessels

Temper	Surface Treatment	Count
Limestone	Plain	15
	Plain (Smoothed over check stamp)	5
	Plain (Smoothed over fabric impressed)	1
	Fabric Impressed	5
	Check Stamped	8
	Simple Stamped	6
	Complicated Stamped	4
	Incised	1
	Zone Punctuated	1
	Tetrapodal Supports	4
Quartz	Plain	2
	Brushed	1
Shell	Fabric Impressed	5
	Simple Stamped	1
	Plain	2
	Eroded	1
No Temper	Check Stamped	1
Total		**62**

(Table modified from Gregory et al. 2011:397)

Table 4.4: Summary of Ceramic Chronology from 40MI70

Date (cal yr. B.P.)	Temper	Surface Treatment
940 - 1,080 B,P.	Limestone	Check Stamped
		Plain
		Smoothed Over Check Stamp
		Zone Punctuated
1,070 - 1,370 B.P.	Limestone	Plain
1,300 - 1,420 B.P.	Limestone	Complicated Stamped
1,340 - 1,730 B.P.	Shell	
	Limestone	Simple Stamped
1,570 - 1,810 B.P.	Limestone	Plain
1,730 - 1,940 B.P.	Limestone	Simple Stamped
1,830 - 2,170 B.P.	Limestone	Plain with podals
2,350 - 2,620 B.P.	Limestone	Fabric Impressed
	Quartz	Fabric Impressed

(Table modified from Gregory et al. 2011:453)

over time.

Based on their analysis, Epsenshade and Tucker found that very few ceramic vessels were represented within both the Late Archaic III and Woodland components (Gregory et al. 2011:464). Drawing heavily on the ethnographic record of semi-sedentary hunter-gatherers (Espenshade 2008a, 2008b, 2008c, 2010; Patch et al. 2011), it was hypothesized that there were never many pots on the site throughout the entire occupational history. This is perhaps because the location was primarily utilized for short-term logistical forays by small family units or task groups whose activities did not necessitate cumbersome ceramic vessels. Activities associated with shellfish gathering and processing can also be accomplished rather quickly and would not necessarily have required task groups to occupy the site for an extended period of time. The lack of ceramic vessels, including cached vessels, may also suggest the use of more perishable containers, including woven baskets and bags for everyday activities.

4.2.2 Paleobotanical Analysis

A large quantity of paleobotanical remains were recovered from each cultural component at the Mussel Beach site, including a variety of locally grown cultigens associated with the Eastern Agricultural Complex (EAC) (Table 4.5). The archaeobotanical dataset, which was analyzed under the supervision of Dr. Leslie Branch-Raymer, was derived from a total of 257 flotation samples collected from 101 cultural features and 41 excavation units. Of the total collected samples, only 57 features and six test units were fully sorted for analysis (Gregory et al. 2011:568). Each of the flotation samples were subjected to machine-assisted water separation in a Shell Mound Archaeological Project (SMAP) flotation device. After processing, recovered light fraction samples were weighed and then passed through a series of nest screens (4.0 mm, 2.36mm, 2.0mm, 1.18mm, 1.0mm, 0.71mm, and .05mm). Of the recovered light fraction material, only the carbonized macroplant remains larger than 2.36 millimeters were analyzed, as any uncharred seeds could represent modern intrusions (Gregory et al. 2011:568). Charred plant remains included in the sample were quantified by material type, weight (wood, resin, nutshell), and/or by count. Of the plant remains that were smaller than 2.36 millimeters, charred acorn shell and seeds were pulled to be included in the analysis.

Additional samples from 54 features and 34 excavation units were passed through nested screens, however they were only subjected to 30 minute scans to identify and record discernable seeds. The relative proportions and quantity of nutshell and wood charcoal was noted, but these samples were not fully sorted and there was no attempt to remove this material or quantify it by count or weight (Gregory et al. 2011:569). The macroplant data were quantified by individual

Table 4.5: Plant Taxa Identified in Each Temporal Component at Mussel Beach

Common Name	**Latin Name**	**Vegetation Type**	**Seasonality**	**LA I**	**LA II**	**LA III**	**MW**	**LW**
Acorn	*Quercus spp.*	Tree	Sept – Nov	X	X	X	X	X
Bean Family	*Fabaceae*						X	
Bedstraw	*Gallium sp.*	Herb	May-August	X	X		X	X
Black Walnut	*Juglans nigra*	Tree	October	X	X	X	X	
Blackberry/Raspberry	*Rubus sp.*	Fruit	June-July				X	
Blueberry	*Vacinnium sp.*	Fruit	July – Oct		X	X		
Burclover	*Medicago sp.*	Herb	July – Sept				X	
Cane	*Arundinaria sp.*	Grass	All Year		X	X	X	X
Cheno-Am	*Chenopodium/Amaranthus*	Herb	June – frost				X	
Cherry/Plum	*Prunus*	Small tree	July – Sept				X	
Deervetch	*Lotus sp.*	Herb	June – Sept				X	
Erect Knotweed	*Polygonum c.f. erectum*	Herb	June – Oct				X	
Goosefoot	*Chenopodium sp.*	Herb	June – frost		X	X	X	
Goosefoot	*Chenopodium c.f. berlandieri*	Herb	June – frost	X	X		X	
Grape	*Vitis sp.*	Vine	Aug – Oct				X	X
Grass Family	*Vitaceae*						X	X
Hawthorne	*Gramineae*	Shrub	Sept – Oct				X	

Table 4.5 (Cont.): Plant Taxa Identified in Each Temporal Component at Mussel Beach

Common Name	**Latin Name**	**Vegetation Type**	**Seasonality**	**LA I**	**LA II**	**LA III**	**MW**	**LW**
Hickory	*Cary asp.*	Tree	October	X	X	X	X	X
Holly	*Ilex sp.*	Tree	All Year				X	X
Honeylocust	*Gleditsia triancanthus*	Shrub	Aug – winter				X	
Ind. Nutmeat		Herb			X		X	
Jointvetch	*Aeschynomene*	Herb	Aug – Sept				X	
Knotweed Family	*Polygonaceae*	Herb	June – Oct		X		X	
Little Barley Grass	*Hordeum pusillum*	Grass	May – June				X	
Maize Cupule	*Zea mays*	Domesticate	June – Oct		X			
Maygrass	*Pharlaris sp.*	Grass	April – June		X	X	X	X
Morning Glory	*Ipomoea sp.*	Herbacious Vine	All Year				X	
Mulberry	*Morus sp.*	Small tree	May – June			X	X	
Nightshade	*Solanum sp.*	Herb	June – Oct				X	
Panic Grass	*Panicum sp.*	Herb	June – Oct				X	
Pigweed	*Amaranthus sp.*	Herb	June – Oct				X	
Pokeweed	*Phytolacca americana*	Herb	May – frost		X		X	X
Sedge	*Cyperus sp.*	Herb	May – Aug				X	
Sesban	*Sesbania sp.*	Herb	July – Sept				X	
Spurge	*Euphorbia sp.*	Herb	June – Oct			X		

Table 4.5 (Cont.): Plant Taxa Identified in Each Temporal Component at Mussel Beach

Common Name	**Latin Name**	**Vegetation Type**	**Seasonality**	**LA I**	**LA II**	**LA III**	**MW**	**LW**
Squash Rind	*Cucurbita sp.*	Herb	June – frost				X	
Sumac	*Rhus sp.*	Shrub	June – Oct		X		X	
Sumpweed	*Iva annua*	Herb	June – frost				X	
Sumpweed/sunflower	*Helianthus/Iva*	Herb	June – frost				X	
Tarweed	*Madia sp.*	Herb	July – Aug				X	
Thistle	*Cirsium sp.*	Herb	June – Oct		X		X	
Tickclover	*Desmodium sp.*	Herb	July – Sept				X	
Unid. Grass	*Gramineae*	Grass			X		X	
Watermelon	*Citrullus sp.*	Domesticate	June – frost				X	

(Adapted from Gregory et al. 2011:562-565) features and then summarized by feature class, structure, and temporal component. What follows is a brief discussion of the macobotanical assemblages from each of the five cultural components and the overall interpretation of plant use at the Mussel Beach site.

The paleobotanical sample from the Late Archaic I component was derived from six samples collected from multiple excavation units. A total of 61 liters of fully sorted, and 15 liters of partially sorted, plant material yielded 0.34 grams of wood charcoal, 120 nutshell fragments, and 14 seeds (Table 4.6). The nutshell consist of hickory (N=112), walnut (N=7), and acorn (N=1) and the seeds recovered include maygrass (N=1), goosefoot (N=1), bedstraw (N=7), and five seeds that were unidentified (Gregory et al. 610). Seeds represent only six percent of the proportion of the recovered macroplant assemblage for the Late Archaic, suggesting that EAC cultigens and seed-bearing fruits were not being extesnively collected for bulking processing or storage.

One hundred and fifty-four liters of plant material were fully sorted from the Late Archaic II sample, with an additional 28 liters of plant material partially scanned for seeds (Gregory et al. 2011:611). The samples yielded 22.17 grams of wood charcoal, a large sample of nutshell (N=6,640), and seeds (N=67) (Table 4.7). The nutshell assemblage was dominated by hickory (N= 6,537), although walnut (N=33), and acorn (N=70) were present. The seed assemblage was comprised of 37 percent EAC cultigens (maygrass, goosefoot, knotweed, squash rind, and sunflower/sumpweed), 45 percent fruit (blueberry, grape, sumac), and 13 percent herbaceous plants (bedstraw, pokeweed, and thistle) (Gregory et al. 2011:611). The relatively substantial amount of nutshell present in the Late Archaic II sample suggests strongly that the collection and bulk processing of nuts was a primary activity during this occupation. The smaller seed assemblage again suggests that EAC cultigens were not a significant part of the diet

Table 4.6: Summary of Plant Taxa Recovered from Late Archaic I Sample

Late Archaic I			
Category	**Common Name**	**Latin Name**	**Count**
Nuts	Acorn nutshell	*Quercus spp.*	1
	Hickory nutshell	*Carya sp.*	112
	Walnut nutshell	*Juglans sp.*	7
Edible Seeds	Goosefoot	*Chenopodium sp.*	1
	Maygrass	*Pharlaris sp.*	1
Herb	Bedstraw	*Gallium sp.*	7
Unidentified			5
Total Seed			**14**

(Table Adapted from Gregory et al. 2011:574-581)

Table 4.7: Summary of Plant Taxa Identified within Late Archaic II Sample

Late Archaic II			
Category	**Common Name**	**Latin Name**	**Count**
Nuts	Acorn nutshell	*Quercus spp.*	70
	Hickory nutshell	*Carya sp.*	6537
	Walnut nutshell	*Juglans sp.*	33
Edible Seeds	Chenopod	*Chenopodium sp.*	7
	Domesticated Chenopod	*Chenopodium c.f. berlandieri*	1
	Knotweed	*Polygonum c.f. erectum*	2
	Maygrass	*Pharlaris sp.*	11
	Squash Rind	*Cucurbita sp*	2
	Sumpflower/Sumpweed	*Helianthus/Iva*	1
Fruit	Blueberry	*Vacinnium sp.*	20
	Grape	*Vitis sp*	1
	Sumac	*Rhus sp.*	7
Herbs	Bedstraw	*Gallium sp.*	2
	Pokeweed	*Phytolacca americana*	5
	Thistle	*Cirsium sp.*	1
Unidentified			
Total Seed Count			**82**

(Table Adapted from Gregory et al. 2011:562-567) at this time, however, it should be noted that the relative number of cultigens exploited did increase with knotweed and sunflower/sumpweed added to the diet.

The Late Archaic III sample included 30 liters of fully sorted plant material and 19 liters of scanned remains. The fully sorted samples yielded 59.69 grams of wood charcoal, and combined, both samples yielded a total of 171 nutshell fragments and 110 seeds (Table 4.8), which seems to be indicative of a major change in subsistence activities at Mussel Beach. Of the total number of seeds recovered, EAC cultigens comprised 95 percent of the assemblage, with fruit (2%) and herbs (3%) accounting for the remaining plants (Gregory et al. 2011:613). The greater overall proportion of cultigens in the Late Archaic III sample suggests that the occupants began to focus their subsistence activities on the collection and processing of cultivated plants foods, rather than the processing large quantities of nuts.

The Middle Woodland component at Mussel Beach represents the most substantial occupation of site 40MI70 (Gregory et al. 2011:615). Plant exploitation during this period increased dramatically, indicating that there was an increased investment in the cultivation and consumption of indigenous plants and a change in subsistence activities (Gregory et al. 2011:614-615). More than 406 liters of plant material were fully sorted from the Middle Woodland occupation, and an additional 164.5 liters was partially scanned. A total of 6,671 nutshells fragments and 4,601 seeds were recovered (Table 4.9) from the Middle Woodland. Also recovered from four Middle Woodland features was a large sample an unknown grass grain, referred to as Unknown Grass Type I. The features include a hearth in Structure I, a thermal pit, and two large storage pits (Gregory et al. 591). In an attempt to identify this unknown grass, New South sent samples to Paleoethnobotanists Kandance Hollenbach and Gayle Fritz. While a conclusive identification has not yet been achieved, Fritz suggested that

Table 4.8: Summary of Plant Taxa Identified in the Late Archaic III Sample

Late Archaic III			
Category	**Common Name**	**Latin Name**	**Count**
Nuts	Acorn nutshell	*Quercus spp.*	10
	Hickory nutshell	*Carya sp.*	157
	Walnut nutshell	*Juglans sp.*	4
Edible Seeds	Chenopod	*Chenopodium sp.*	1
	Maygrass	*Pharlaris sp.*	95
Fruit	Blueberry	*Vacinnium sp.*	1
	Mulberry	*Morus sp.*	1
Herb	Spurge	*Euphorbia sp.*	3
Total Seed			**110**

(Table After Gregory et al. 2011)

Unknown Grass Type I may represent river cane (*Arundinaria* sp.). The identification of carbonized cane fragments in the Late Archaic and Middle Woodland deposits indicates that cane was definitely utilized at Mussel Beach, although the extent of use is still unknown (Gregory et al. 2011:589). The carbonized fragments were recovered as flotation samples from several different feature types (Table 4.10), including shell-processing middens, storage and thermal pits.

Because cane processing for use as a basket material has been well documented ethnographically, and observed directly during the ethnoarchaeological experiments, it was hypothesized that it would be possible to examine the carbonized samples to determine if they had been processed as weaving splits. If the cane samples retained the exterior cuticle and epidermis, as well as the interior fibers with vascular bundles, this would suggest that the cane had not been peeled and processed for weaving. When analyzing carbonized cane fragments, it

Table 4.9: Summary of Plant Taxa Identified in Middle Woodland Sample

Middle Woodland			
Category	**Common Name**	**Latin Name**	**Count**
Nuts	Acorn nutshell	*Quercus spp.*	687
	Hickory nutshell	*Carya sp.*	5882
	Walnut nutshell	*Juglans sp.*	102
Edible Seeds	Cheno-Am	*Chenopodium/Amaranthus*	8
	Erect Knotweed	*Polygonum c.f. erectum*	1
	Chenopod	*Chenopodium sp.*	941
	Domesticated Chenopod	*Chenopodium c.f. berlandieri*	859
	Knotweed family	*Polygonaceae*	1
	Knotweed	*Polygonum c.f. erectum*	16
	Little Barely	*Hordeum pusillum*	11
	Maygrass	*Pharlaris sp.*	1456
	Pigweed	*Amaranthus sp.*	3
	Squash Rind	*Cucurbita sp*	13
	Squash Seed	*Cucurbita sp*	1
	Sumpweed	*Iva*	2
	Sumpflower/Sumpweed	*Helianthus/Iva*	11
	Blueberry/Rasberry	*Vacinnium sp.*	26
	Cherry/Plum	*Prunus*	2
	Grape	*Vitis sp*	10
Fruit			
	Hawthorne	*Gramineae*	4
	Honeylocust	*Gleditsia triancanthus*	236
	Mulberry	*Morus sp.*	49
	Strawberry	*Frageria spp.*	4
	Sumac	*Rhus sp.*	4
	Watermelon	*Citrullus sp.*	1

Table 4.9 (Cont.): Summary of Plant Taxa Identified in Middle Woodland Sample

Category	**Common Name**	**Latin Name**	**Count**
Grass	Grass Family	*Gramineae*	2
	Panic Grass	*Panicum sp*	2
	Unidentified Grass	*Gramineae sp.*	383
Herb	Bean family	*Fabaceae*	4
	Bedstraw	*Gallium sp.*	32
	Burclover	*Medicago sp.*	20
	Deervetch	*Lotus sp.*	1
	Holly	*Ilex sp.*	5
	Jointvetch	*Aeschynomene*	1
	Morning Glory	*Ipomoea sp.*	1
	Nightshade	Solanum sp.	10
	Pokeweed	Phytolacca americana	3
	Sedge	Cyperus sp.	2
	Coffeeweed	Sesbania sp.	2
	Spurge	Euphorbia sp.	2
	Tarweed	Madia sp.	1
	Thistle	Cirsium sp.	4
	Tickclaw	Desmodium sp.	77
Unidentified			376
Total Seed			**4587**

(Table After Gregory et al. 2011)

Table 4.10: Summary of Features in which Carbonized Cane Specimens were recovered at Mussel Beach Site

Feature	Block	Trench	Locus	Midden Area	Temporal Component	Calibrated Radiocarbon Age	Feature Type
424	A		6		LA II	3,890-4,100	Thermal Pit
43			1		MW	1,830-2,000	Shell-Processing Midden
340		12		4	MW	1,570-1,810	Shell-Processing Midden
256			6		LW	1,050-1,260	Shell-Processing Midden
454	A		6		LA II		Thermal Pit
406	A		6		LA III	2,350-2,620	Storage Pit
351		9		1	LW	940-1,080	Shell-Processing Midden
383	A		6		MW	2,360-2,940	Refuse Midden
258					MW	1,370-1,070	Earth Oven
343		12		4	MW		Thermal Pit

appears that most scholars have only attempted to identify the carbonized specimens by species, and did not consider the kinds of information that might be achieved had the extact condition of the sample been examined as well. Samples of cane that lacked the soft interior rind, or conversely lacked the waxy cuticle and upper epidermis, would suggest that the cane had been processed for weaving splits. To my knowledge this is the first attempt that there has been to make such determinations within archaeologically derived samples.

I examined each of the carbonized cane samples under the direct supervision of Paleoethnobotanist Kandace Hollenbach at the Archaeological Research Laboratory. The specimens were examined using an Olympus SZ61 Stereoscopic microscope equipped with 10x oculars and magnification capabilities ranging from .67 to 4.5x. Based on the microscopic analysis of the specimens, it was found that the majority of the carbonized cane samples were remnants of the inner vascular rind that had been removed or peeled away from the exterior cuticle. A small sample of specimens were identified as primarily the exterior cuticle portion of the culm (Figure 4.3) and only a single specimen appears not to have been processed at all, which means it retained the outer cuticle as well as the soft inner rind (see Table 4.11). Each of the specimens were quite distinctive, and it was not difficult to identify specimens that were missing the outer cuticle. It was obvious that the carbonized culm fragments from Mussel Beach share similarities to the refuse produced during the experimental peeling and stripping of the cane, and are therefore seen as direct evidence for the processing of river cane at the Mussel Beach site. The success of this approach will hopefully allow analysts to recognize similar processing events in other archaeological contexts.

The paleobotanical assemblage from the Late Woodland component is modest compared to the Middle Woodland, and the total proportion of seeds relative to nutshell is more similar to the Late Archaic II than the Late Archaic III and Middle Woodland occupations (Gregory et al. 2011:617). The sample size, however, is related more to preservation conditions and site taphonomy than the actual use of plants during the Late Woodland. The Late Woodland sample was derived from 52 liters of fully sorted material and 113.5 liters of scanned plant remains (Table 4.12). Overall the sample yielded 4.16 grams of wood charcoal, 286 nutshell fragments, and 55 seeds. While seed counts are substantially lower, the relative proportion of EAC cultigens present in the Late Woodland sample does suggest that plant cultivation and gardening activities remained important, with fruits and herbs still being supplemented in the diet. A decrease in the bulk processing of mast resources is evident, and the low densities of wood charcoal suggests that during the Late Woodland site 40MI70 was occupied during warmer seasons (Gregory et al. 2011:618).

A recent analysis of a much larger sample of the paleobotanical assemblage from Mussel

Figure 4.3: Carbonized Sample of Inner Fibrous Material of Cane Culm (Top); Carbonized Specimen of Peeled Outer Cuticle of Cane Culm (Bottom).

Table 4.11: Summary of Carbonized Cane Samples from 40MI70

Bag Number	Sample Number	Feature	Time Period	Cane Treatment	Count	Weight (g)
1025	7573	424	LA II	Interior Rind	19	0.13
				Exterior Cuticle	9	0.09
				Unprocessed		
833	6719	43	MW	Interior Rind	6	0.11
				Exterior Cuticle		
				Unprocessed		
1011	7503	340	MW	Interior Rind	27	0.1
				Exterior Cuticle	3	0.02
				Unprocessed		
828	6698		MW	Interior Rind	24	0.15
				Exterior Cuticle		
				Unprocessed		
1061	7840		MW	Interior Rind		
				Exterior Cuticle	3	0.05
				Unprocessed		
955	7179	343	MW	Interior Rind	4	0.08
				Exterior Cuticle		
				Unprocessed		
1064	7875	424	LA II	Interior Rind	2	0.02
				Exterior Cuticle		
				Unprocessed		
886	6923			Interior Rind	5	0.01
				Exterior Cuticle		
				Unprocessed		
927	7057		MW	Interior Rind	3	0.06
				Exterior Cuticle		
				Unprocessed		
1081	8054	258	MW	Interior Rind	3	0
				Exterior Cuticle		
				Unprocessed		
1069	7915			Interior Rind	2	0
				Exterior Cuticle		
				Unprocessed	1	0.01
956	7183		MW	Interior Rind	6	0.01
				Exterior Cuticle		
				Unprocessed		
1075	7975	256	LW	Interior Rind	6	0.01
				Exterior Cuticle		
				Unprocessed		

Table 4.11 (Cont.): Summary of Carbonized Cane Samples from 40MI70

Bag Number	Sample Number	Feature	Time Period	Cane Treatment	Count	Weight (g)
853	6805			Interior Rind	2	0
				Exterior Cuticle		
				Unprocessed		
1065	7890	454	LA II	Interior Rind	5	0.13
				Exterior Cuticle		
				Unprocessed		
986	7363	406	LA III	Interior Rind	5	0
				Exterior Cuticle		
				Unprocessed		
943	7122	351	LW	Interior Rind	3	0
				Exterior Cuticle		
				Unprocessed		
970	7269			Interior Rind	4	0
				Exterior Cuticle		
				Unprocessed		
1000	7468		MW	Interior Rind	8	0.06
				Exterior Cuticle		
				Unprocessed		
1026	7586	383	MW	Interior Rind	14	0.09
				Exterior Cuticle		
				Unprocessed		
1004	7481		LA II	Interior Rind	7	0.2
				Exterior Cuticle		
				Unprocessed		

Table 4.12: Summary of Plant Taxa Identified in Late Woodland Sample

Late Woodland			
Category	**Common Name**	**Latin Name**	**Count**
Nuts	Acorn nutshell	*Quercus spp.*	28
	Hickory nutshell	*Carya sp.*	258
Edible Seeds	Cheno-Am	*Chenopodium/Amaranthus*	1
	Chenopod	*Chenopodium sp.*	1
	Maygrass	*Pharlaris sp.*	102
Fruit	Blueberry/Rasberry	*Vacinnium sp.*	5
	Grape	*Vitis sp*	6
	Mulberry	*Morus sp.*	1
	Strawberry	*Frageria spp.*	1
Grass	Grass Family	*Gramineae*	2
Herb	Bedstraw	*Gallium sp.*	1
	Holly	*Ilex sp.*	1
	Pokeweed	*Phytolacca americana*	1
Unidentified			49
Total Seed Count			171

(Table after Gregory et al. 2011)

Beach was conducted by Stephen Caromody as part of a dissertation (Carmody 2015: 352). By looking at the seasonality of occupations based the presence of certain plant remains (Table 4.13), as opposed to return rates, Carmody concluded that the Mussel Beach site was occupied much more frequently, and more extensively, than previously thought. He notes that by the Late Archaic Mussel Beach was being used more intensively in both the Fall and Spring for the collection of local cultigens, including wild and domesticates species of chenopod, as well as the bulk collection of mast resources. Based on these findings, Carmody (2014) suggested that the Late Archaic occupations do not represent simple fall logistical camp sites as Gregory had implied (Gregory et al. 2011:647), but instead likely saw a longer habitation. He suggests that intensive gardening practices, which often characterize later Woodland sites, begin during the Late Archaic III, and essentially set the stage for later more intensive horticultural activities which develop during the Middle Woodland component at Mussel Beach. The presence large quantities of EAC cultigens and domesticated chenopod indicated intensive horticultural practices and considerable investment in the environment through the maintenance of local garden plots.

4.2.3 Faunal Analysis

Faunal remains, in the form of both vertebrate and invertebrate taxa, were recovered from sampled proveniences at site 40MI70 (Table 4.14). Vertebrate and invertebrate remains were collected from four of the five temporal components; they were absent from the Late Archaic I occupation and the sample from the Late Archaic II was extremely small and offered little in the way of quantification and interpretation (Gregory et al. 2011:536). The invertebrate faunal remains were recovered using 0.25-inch screens, 2.0 millimeter screens for heavy fractions, while the invertebrates, including several different species of bivalves and gastropods, were

Table 4.13: Summary of Plant Taxa and Season of Harvest from 40MI70

Seasonality	**Common Name**	**Latin Name**	**LA I**	**LA II**	**LA III**	**MW**	**LW**
Spring/Early Summer	Little Barley	*Hordeum pusillium*				X	
Spring/Early Summer	Maygrass	*P.caroliniana*	X	X	X	X	X
Summer	Red Mulberry	*Morus rubra*			X	X	X
Mid to Late Summer	Blackberry/ Raspberry	*Rubus sp.*		X		X	X
Mid to Late Summer	Blueberry	*Vaccinium sp.*			X	X	
Mid-Summer/Fall	Cherry/Plum	*Prunus sp.*				X	
Mid-Summer/Fall	Grape	*Vitis sp.*				X	X
Late Summer/Fall	Amaranth	*Amaranthus sp.*				X	
Late Summer/Fall	Chenopod	*Chenopodium sp.*	X	X	X	X	X
Late Summer/Fall	Curcubitis	*Cucurbita pepo*		X		X	
Late Summer/Fall	Honey Locust	*Gleditisia triacanthos*				X	
Late Summer/Fall	Knotweed	*Polygonum sp*		X		X	
Late Summer/Fall	Sumac	*Rhus spp*		X		X	
Late Summer/Fall	Sumpweed	*Iva annua.*				X	
Late Summer/Fall	Sunflower	*Helianthus sp*				X	
Fall	Acorn	*Quercus spp.*	X	X	X	X	X
Fall	Black Walnut	*Juglans nigra.*				X	
Fall	Hawthorne	*Crataegus spp.*				X	
Fall	Hickory	*Carya spp.*	X	X	X	X	X

(Table after Carmody 2014)

Table 4.14: Vertebrate Assemblage by Locus for Each Temporal Component at Mussel Beach

Locus	Midden Area	Component	NISP/n	Weight (g)
1		Middle Woodland	7	12.4
1		Late Archaic III	7	4.79
1		Modern	5	8.42
1		Middle Woodland	77	83.25
1		Various	2	5.2
4		Middle Woodland	4	4.48
6		Late Archaic III	16	9.14
6		Late Archaic II	37	20.81
6		Late Archaic III	190	210.31
5		Late Woodland	9	3.14
5		Middle Woodland	366	433.95
5		Middle Woodland/Late Archaic	3	22.57
5		Middle Woodland/Late Archaic	23	63.52
5		Middle Woodland/Late Woodland	14	13.57
5		Unknown	2	0.5
5		Various	2	0.31
	1	Late Woodland	28	34.45
	1	Middle Woodland	3	1.03
	3	Middle Woodland	159	28.63
	4	Middle Woodland	107	114.87
	4	Various	1	1.02
	5	Late Archaic III	3	2.13
	5	Various	2	0.68
	6	Late Archaic II	1	0.38
	6	Late Archaic III	6	0.86
Total			**1,074**	**1080.41**

(Adapted from Gregory et al. 2011:482-483) selected from mollusk shell samples (Table 4.15). The identification of vertebrate specimens were accomplished using comparative collections from New South Associates and collections curated at the University of Georgia Zooarchaeological Laboratory in Athens, Georgia (Gregory et al. 2011:484). Gastropod and bivalve taxa were identified with the aid of identification guides, comparative collections housed at the Mollusk Research Collection located at McClung Museum at the University of Tennessee, Knoxville, and through consultations with malacology experts at McClung Museum (Gregory et al. 2011:485).

A total of 1,074 vertebrate specimens (Tables 4.16) and 2,478 invertebrate bivalves and gastropods (Tables 4.17 and 4.18) were analyzed by New South Associates. Analysis of the faunal assemblages included the count and weight of most specimens. Attempts were also made to calculate the number of identified specimens (NISP) either by species or some higher category, as well as the minimum number of individuals (MNI) (Gregory et al. 2011:487-488). NISP can be used as a means to monitor, both spatially and temporally, changes in frequency of faunal remains at archaeological sites (Grayson 1984:17). MNI was developed to account for differential deposition of remains that result from butchering activities and as a way to calculate meat contribution from various taxa (Grayson 1984:27).

What follows is a discussion of the zooarchaeological assemblages from each the temporal components at Mussel Beach. Included are reviews of both the vertebrate and invertebrate faunal assemblages as well as a discussion about the purported shell tool assemblage. The zooarchaeological assemblages were analyzed primarily by New South Associates and interpretations were made regarding the major subsistence activities that took place during each of the occupations. The discussion begins with the Late Archaic II component, as no faunal materials were covered from the Late Archaic I.

Table 4.15: Analyzed Invertebrate Sample from Mussel Beach

Locus	Midden Area	Component	NISP/n	Weight (g)
1		Middle Woodland	426	5915.6
4		Late Woodland	17	810.38
6		Late Archaic III	60	2068.55
6		Late Woodland	155	2563.21
6		Middle Woodland	991	14922.26
	1	Late Woodland	260	4990.27
	3	Middle Woodland	158	4166.91
	4	Middle Woodland	411	9371.4
Total			**2,478**	**44,808.58**

(Adapted from Gregory et al. 2011:483)

As previously noted, the faunal assemblage from the Late Archaic II was minimal and did not represent a significant contribution to the overall archaeological assemblage (Gregory et al. 2011:536). The sample, which contained only vertebrates, consisted of a totaled 38 specimens (21.19 grams, NISP=15, S=7) recovered primarily Locus 6. The vertebrate taxa included bird (NISP=8), reptile (NISP=3), mammal (NISP=3), and fish (NISP=1). Of these remains, previous investigators were only able to identify two specimens below the class level, one differentiable species of catfish and one white-tailed deer (Gregory et al. 2011:536) The remaining specimens were unidentifiable (n=23).

A taphonomic analysis of the faunal remains revealed that many of the bones showed evidence of both butchering and thermal alteration (NISP=19). A total of four specimens were burned and fourteen display cut marks consistent with primary dismemberment and skinning as well as spiral fractures of the long bones, which likely represents the extraction of marrow (Gregory et al. 2011:536). The bones also show evidence for secondary taphonomic

Table 4.16: Summary of Vertebrate Specimens Recovered from 40MI70

Class	Order	Family	Genus and Species	Common Name	NISP/n	Weight(g)
	N/A	N/A	N/A	Unidentifiable Fish	9	4.6
	Perciformes	Sciaenidae	Aplodinotus grunniens	Drum	6	27.29
Actinopterygii	Perciformes	N/A	N/A	Unidentifiable Perciform	2	1.16
	Semionotiformes	Lepisosteidae	Lepisosteus sp.	Gar	3	0.71
	Siluriformes	Iclaturide	Iclaturide sp.	Unidentifiable Catfish	4	1.98
	Galliformes	Phasianidae	N/A	Possible Turkey	1	1.36
	Galliformes	Phasianidae	Meleagris gallopavo	Turkey	2	2.25
Aves	N/A	N/A	N/A	Unidentifiable Bird	46	22.22
	Strigiformes	Tytonidae	Tyoto alba	Barn Owl	1	0.28
	Strigiformes	Strigidae	Bubo virginianus	Great Horned Owl	1	0.3
	Carnivora	Procyonidae	Procyon lotot	Racoon	6	9.75
	Artiodactyla	Cervidae	Odocoileus virginianus	White-tailed Deer	61	254.31
	N/A	N/A	N/A	Unidentifiable Mammal	3	3.51
Mammalia	N/A	N/A	N/A	Unidentifiable Mammal	1	0.45
	N/A	N/A	N/A	Unidentifiable Mammal	245	336.82
	N/A	N/A	N/A	Unidentifiable Rodent	7	0.77
	N/A	N/A	N/A	Unidentifiable small mammal	3	0.45

Table 4.16 (Cont.): Summary of Faunal specimens recovered from 40MI70

Class	**Order**	**Family**	**Genus and Species**	**Common Name**	**NISP/n**	**Weight(g)**
	N/A	N/A	N/A	Unidentifiable Squirrel	7	1.17
	Crocidilia	Alligatoridae	Scurius sp.	Alligator	2	0.4
	Testudines	Emydidae	Terrapene carolina	Box Turtle	3	1.11
Reptilia	Testudines	N/A	N/A	Unidentifiable Turtle	190	83.83
	Testudines	Trionchidae	N/A	Unidentifiable Soft Shell Turtle	21	25.71
	Testudines	Chelydridae	Chelydra serpentina	Snapping Turtle	2	1.58
Unidentifiable	N/A	N/A	N/A	Unidentifiable Vertebrate	447	294.44

(Table after Gregory et al. 2011)

Table 4.17: Summary of Identified Invertebrate Specimens from 40MI70

Class	Order	Family	Genus and Species	Common Name	NISP/n	Weight(g)
Bivalvia	Unionoida	Unionoidae	Actinonasias ligamentina	Mucket	49	1252.4
Bivalvia	Unionoida	Unionoidae	Actinonasias ligamentina	Mucket c.f.	2	26.91
Bivalvia	Unionoida	Unionoidae	Amblema plicata	Threeridge	10	459.45
Bivalvia	Unionoida	Unionoidae	Dromus dromus	Dromedary Pearlmussel	196	3668.76
Bivalvia	Unionoida	Unionoidae	Dromus dromus c.f.	Dromedary Pearlmussel c.f.	1	10.96
Bivalvia	Unionoida	Unionoidae	Ellipsaria lineolata	Butterfly	212	3333.18
Bivalvia	Unionoida	Unionoidae	Ellipsaria lineolata c.f.	Butterfly c.f.	3	26.2
Bivalvia	Unionoida	Unionoidae	Elliptio crassidens	Elephant Ear	18	189.13
Bivalvia	Unionoida	Unionoidae	Elliptio sp.	Elliptio sp.	1	5.76
Bivalvia	Unionoida	Unionoidae	Epioblasma sp.	Epioblasma sp.	1	17.04
Bivalvia	Unionoida	Unionoidae	Epioblasma torulosa	Tubercled Blossum	168	2450.37
Bivalvia	Unionoida	Unionoidae	Fusconaia subtrodunda	Longsolid	8	109.45
Bivalvia	Unionoida	Unionoidae	Obovaria retusa	Ring Pink	19	493.2
Bivalvia	Unionoida	Unionoidae	Obovaria retusa c.f	Ring Pink c.f	6	176.67
Bivalvia	Unionoida	Unionoidae	Plethobasus cooperianus	Orangefoot Pimpleback	164	2824.19
Bivalvia	Unionoida	Unionoidae	Plethobasus plenum or rubrum	Rough or Pyramid Pigtoe	572	10,826.79
Bivalvia	Unionoida	Unionoidae	Pluurobema sp./Obovaria retuse	Pyramid Pigtoe/Ring Pink	1	40.3
Gastropada	Architaenioglossa	Viviaridae	Campeloma sp.	Campeloma sp.	146	538.29
Gastropada	Neotaenioglossa	Pleuroceridae	Pluerocera sp.	Hornsnail	290	553.63
Gastropada	Neotaenioglossa	Pleuroceridae	Pluerocera c.f.	Hornsnail c.f.	1	2.21
Gastropada	Stylommatophora	Discadae	Anguispira alternata	Flamed Tigersnail	210	6.4

(Table after Gregory et al. 2011)

Table 4.18: Summary of Invertebrates Recovered from Mussel Beach by Temporal Component

Class	Common Name	Latin Name	LA III	MW	LW
Bivalve	Butterfly	Ellipsaria lineolata	3	159	50
Bivalve	Dromedary Pearlymussel	Dromus dromus	3	137	56
Bivalve	Elephant Ear	Elliptio crassidens		10	8
Bivalve	Epioblasma sp.	Epioblasma sp.			
Bivalve	Longsolid	Fusconaia subtrodunda		5	3
Bivalve	Mucket	Actinonasias ligamentina	1	25	13
Bivalve	Orangefoot Pimpleback/Purple Wartback	Plethobasus cooperianus	2	140	22
Bivalve	Ring Pink	Obovaria retusa	1	16	2
Bivalve	Rough or Pyramid Pigtoe	Plethobasus plenum or rubrum	21	481	71
Bivalve	Three Ridge	Amblema plicata		10	
Bivalve	Tubercled Blossom	Epioblasma torulosa	3	142	23
Gastropod	Campeloma sp.	Campeloma sp.	8	128	10
Gastropod	Hornsnail	Pluerocera sp.	9	265	16
Gastropod	Flamed Tigersnail	Anguispira alternata	5	147	58
Totals			**56**	**1665**	**332**

(Table after Carmody 2015:104)

modification, including erosion of the bone surface, abrasion, and root activity. While the Late Archaic II assemblage is small, taphonomic evidence suggests that the occupants used Locus 6 to butcher and process a variety of vertebrate animals.

The faunal assemblage recovered from the Late Archaic III component was significantly larger than that of the Late Archaic II and contained both vertebrate and invertebrate remains. The vertebrate sample, which totaled 206 specimens (NISP=145), was recovered from Locus 1 and 6, as well as Midden Areas 5 and 6. The vertebrates identified by taxonomic class included fish (NISP=3), reptiles (NISP=47), birds (NISP=6), and mammals (NISP=87); the remaining specimens were all unidentifiable vertebrates (n=61) (Gregory et al. 2011:537). The specimens identified below the class level included gar (NISP=2), raccoon (NISP=3), undifferentiated rodent (NISP=7), white-tailed deer (NISP=13), box turtle (NISP=2), snapping turtle (NISP=2), and softshell turtle (NISP=8) (Gregory et al. 2011:537). Primary taphonomic modification observed on the vertebrate sample included both thermal alteration and evidence of butchering. Secondary taphonomic modification of the assemblage revealed evidence of erosion, abrasion, root activity, and some carnivore gnawing (Gregory et al. 2011:538).

The invertebrate sample from the Late Archaic III component was recovered from Locus 6, and was relatively small compared with later Middle Woodland faunal assemblages (NISP=56). The majority of the Late Archaic III sample contained several different species of bivalves and a small sample of gastropods. The bivalve taxa represented within this temporal component included butterfly valve (NISP=3), dromedary pearlymussel (NISP=3), mucket valve (NISP=1), orangefoot pimpleback or purple wartyback (NISP=2), ring pink (NISP=1), rough or pyramid pigtoe (NISP=21) and tubercled blossom (NISP=3). The gastropods included campeloma (NISP=8), flamed tigersnail (NISP=5), and hornsnail (NISP=9).

The Middle Woodland component at Mussel Beach was the most intensively occupied and this is represented by both large vertebrate and invertebrate assemblages. Vertebrate remains were recovered from Loci 1 and 6 as well as Midden Areas 1, 3, and 4, and consisted of a total of 723 (NISP=403) specimens (Gregory et al. 2011:541). Taxa identified by class included birds (NISP=32), fish (NISP=14), mammals (NISP=197), and reptiles (160). The remaining 320 specimens were unidentifiable. Those specimens identified beyond taxonomic class included drum (NISP=3), gar (NISP=1), catfish (NISP=3), undifferentiated perciform (NISP=1), barn owl (NISP=1), great horned owl (NISP=1), turkey (NISP=2), squirrel (NISP=7), white-tailed deer (NISP=36), possible alligator (NISP=2), box turtle (NISP=1), and undifferentiated softshell turtle (NISP=13) (Gregory et al. 2011:541). A large portion of this assemblage contained specimens with evidence of thermal alteration (n=154), cut marks, and fractures associated with butchering activities (n=118). Evidence of butchering was observed on the bone of turkeys, squirrels, white-tailed deer, and undifferentiable species of bird and mammals (Gregory et al. 2011:541). Secondary modification included erosion, abrasion, minor root activity, and evidence of carnivore gnawing.

The large Middle Woodland invertebrate sample (NISP=1686) came from dense midden accumulations located in Loci 1 and 6 and Midden Areas 3 and 4 (see Table 4.18) The assemblage was primarily represented by bivalves (NISP=1145), of which the taxa included butterfly (NISP=159), dromedary pearlymussel (NISP=137), elephant ear (NISP=10), longsolid (NISP=5), mucket (NISP=25), orangefoot pimpleback or purple wartyback (NISP=140), ring pink (NISP=16), rough or pyramid pigtoe (NISP 481), threeridge (NISP=10), and tubercled blossom (NISP=142) (Gregory et al. 2011:542). The remaining assemblage of invertebrates were gastropods (NISP=541), and the taxa that were identified include campeloma (NISP=128), flamed tigersnail (147), and hornsnail (NISP=265) (Gregory et al. 2011:542).

The bivalves represented in the Middle Woodland sample include species that spawn in both spring/summer and fall/winter, demonstrating that site 40MI70 was occupied or at least exploited on a year-round basis (Gregory et al. 2011:542). Evidence for year-round processing of shellfish is primarily located within Locus 6 and Midden Area 4, however there is also evidence for strictly warm weather processing within Midden Area 3 and Locus 1 (Gregory et al. 2011:542). Many of the bivalves exploited would have been found in shallow sand/gravel substrates, which suggests that they were most likely collected by hand, however other procurement methods, such as nets, were likely to have been employed for those species located in deeper water.

While a small sample of the shell specimens from the Middle Woodland assemblage were modified through thermal alteration (n=22), a large percentage appear to have been culturally modified (NISP=478) for use as tools (Table 4.19) (Gregory et al. 2011:542). Made from a variety of bivalve species, the probable shell tools have been characterized by Gregory et al. as expedient in nature and appear to be cut, notched (single, double, and squared), and incised. Also included within the assemblage of shell tools are drill-like implements, knives, and scrapers (2011:543). Because freshwater shell tools are uncommon in the archaeological record of the Southeast, Gregory et al. (2011), do note that the modification observed on some specimens could have been the result of shucking activities and/or post-depositional processes, rather than intentional human modification.

An overall interpretation of the invertebrate assemblage from the Middle Woodland suggests that the zooarchaeological remains were processed and disposed of within open contexts where several different cultural activities took place (Gregory et al. 2011:543).

Table 4.19: Summary of Invertebrate Species with Evidence of Human Modification by Location at Mussel Beach Site.

Location	Common Name	NISP/n
	Butterfly	8
	Dromedary Pearlymussel	3
	Ellitptio sp.	1
	Longsolid	1
Locus 1	Mucket	1
	Orangefoot Pimpleback/Purple Wartback	2
	Ring Pink	1
	Rough or Pyramid Pigtoe	30
	Three Ridge	1
	Tubercled Blossom	7
	Undifferentiated Bivalve/Gastropod	38
	Butterfly	21
	Dromedary Pearlymussel	19
	Mucket	5
Locus 6	Orangefoot Pimpleback/Purple Wartback	13
	Rough or Pyramid Pigtoe	90
	Tubercled Blossom	11
	Undifferentiated Bivalve/Gastropod	26
	Butterfly	4
	Dromedary Pearlymussel	4
	Mucket	3
	Orangefoot Pimpleback/Purple Wartback	9
Midden Area 3	Ring Pink	2
	Rough or Pyramid Pigtoe	31
	Three Ridge	3
	Tubercled Blossom	4

Table 4.19 (Cont.): Summary of Invertebrate Species with Evidence of Human Modification by Location at Mussel Beach.

Location	Common Name	NISP/n
	Undifferentiated Bivalve/Gastropod	19
	Butterfly	12
	Dromedary Pearlymussel	7
	Orangefoot Pimpleback/Purple Wartback	10
Midden Area 4	Ring Pink	4
	Rough or Pyramid Pigtoe	45
	Three Ridge	3
	Tubercled Blossom	5
	Undifferentiated Bivalve/Gastropod	25
Total		**478**

(Table Adapted from Gregory et al. 2011)

Processed bivalves and gastropods were subjected to some thermal alteration as the result of cooking activities, fragmentation from foot traffic, and they were also exposed to natural elements which resulted in the erosion and abrasion of the specimens. Gregory et al. acknowledge that the morphological categories in which the shell tools were placed, are not intended to represent definitive morphological types, but rather represent initial observations and hypotheses that require future testing (Gregory et al. 2011:545).

The vertebrate and invertebrate assemblages associated with the Late Woodland component is relatively small compared to the Middle Woodland occupation. The vertebrate sample, which contained only 37 specimens (NISP=21), was recovered primarily from Midden Area 1 and Locus 6. The taxa included fish (NISP=2), birds (NISP=1), mammals (NISP=15), reptiles (NISP=3), and 16 specimens which were unidentifiable. Of the faunal assemblage, drum

(NISP=2), white-tailed deer (NISP=1), and undifferentiated turtle (NISP=3) were identified below taxonomic class (Gregory et al. 2011:545). A small percentage of the vertebrate remains did show signs of burning, or calcination, and a much higher proportion exhibited spiral fractures associated with butchering. The remains also showed evidence of secondary modifications, including erosion, abrasion, and root activity (Gregory et al. 2011:545).

The Late Woodland invertebrate sample (NISP=336) was substantially larger than the vertebrate assemblage and was represented primarily by bivalves (NISP=252), which were recovered from Loci 4 and Midden Area 1. Species of bivalve from the Late Woodland include butterfly (NISP=50), dromedary pearlymussel (NISP=56), elephant ear (NISP=8), longsolid (NISP=30, mucket (NISP=13), orangefoot pimpleback or purple wartyback (NISP=22), ring pink (NISP=2), rough or pyramid pigtoe (NISP=71), and tubercled blossom (NISP=23). The gastropods were identified as campeloma (NISP=10), flamed tigersnail (NISP=58), and hornsnail (NISP=16) (Gregory et al. 2011:546).

The distribution of bivalve species within the Late Woodland sample suggests that strategies of exploitation and procurement changed very little from the Middle Woodland period. Shellfish and gastropods continued to be exploited year-round from shallow shoal environments, and there is also evidence of a singular fall/winter occupation located within Locus 6 (Gregory et al. 2011:546). Modified shells were also recovered from the Late Woodland invertebrate assemblage (n=157). Thirty-nine bivalves show evidence of burning and the remaining specimens appear to have been culturally modified into tools (n=120) (Gregory et al. 2011:546). These purported tools are similar in morphology as those recovered from the Middle Woodland. Primary taphonomic evidence, or rather a lack of, from the Late Woodland faunal assemblages suggest that the remains were discarded on the surface as part of a quick depositional event, but underwent limited foot traffic before being buried by natural processes (Gregory et al. 2011:457).

In general, the faunal assemblages recovered and analyzed from Mussel Beach are similar to other Archaic and Woodland sites of the Tennessee Valley region. When compared to other regional sites of this period, Mussel Beach differs in that the assemblage was absent of formalized bone tools and shell ornaments, such as beads or gorgets which are often associated with burial contexts. Throughout its occupation, site 40MI70 served as a temporary camp with specialized activity areas. The site saw repeated occupations throughout the year wherein shellfish collection and processing were a primary focus. The repeated occupation of the site shows that it was visited by successive generations, but the intensity and duration in which the site was used fluctuated over time.

In 2015 I conducted preliminary study of the purported shell tool assemblage from Mussel Beach with the help of a fellow graduate student, Martin Walker. The goal of the analysis was to: 1) create type categories for the shell tools based on similar morphological characteristics; 2.) test various manufacturing techniques through experimental applications; and 3.) explore trampling as a post-depositional process that may have caused shell breakage patterns (King and Walker 2015). Based on the preliminary examination of the shell tool assemblages, four distinct tool types were identified based on shared physical characteristics. These categories were not very different from those proposed by Gregory et al. (2011). As mentioned above, Gregory et al. identified the following categories of shell tools: cut, notched (single, double, square), incised umbo, drill-like, and knives/scrapers. The first two of four categories identified herein include shells with distinctive square (Figure 4.4) and v-notches (Figure 4.5). The notches on these specimens differed with respect to size, but in general the shapes of the notches

Figure 4.4: Distinctive Square-notched Shell Implements from Mussel Beach

Figure 4.5: V-notched Shell Tools with Lateral Abrasions

could be distinguished as either squared or v-shaped. While the notches were initially a distinguishing characteristic of these artifacts, it also became obvious that the majority of the shells bearing square and v-shaped notches also exhibited localized patches of wear or abrasion on the dorsal surface of the shell where the periostracum, or thin organic coating, had been removed or worn away. The wear is typically restricted to the lateral margin containing the notch and this distinctive pattern of abrasion does not appear on shells without modification.

The next category of shells are those that are missing posterior and anterior margins, but exhibit a rounded protrusion. In some instances, the rounded protrusions appears to have been retouched along the margins (Figure 4.6). This particular class of shell tools are usually missing several of outer organic layers, and thus have a pearly or lustrous appearance compared to the other specimens. Unfortunately this distinguishing feature can make it difficult to accurately determine the species of the shell. The fourth morphological type identified among the Mussel Beach shell assemblage include shells with at least one straight edge, or rather shells with only one intact posterior or anterior margin (Figure 4.7). Many of these specimens also exhibit patterns of localized wear or abrasion on the dorsal surface of a single margin. The abrasion is again localized, seemingly restricted to only one of the shell margins. Although additional studies and experimentation are required, it is hypothesized that these wear patterns are related to prehension or tool hafting.

In addition to the four primary categories identified are two additional classes of modified specimens which do not fit neatly within any morphological category. The first assemblage of specimens exhibit varying forms of modification, and have been described elsewhere as knives or scrapers (Figure 4.8) (Gregory e al. 2011). Unlike the other tool categories, this group of tools are much less frequent within the total tool assemblage, but their

Figure 4.6: Shell Implements with Rounded Protrusions

Figure 4.7: Shell Implements with Straight Lateral Margins and Lateral Abrasions

Figure 4.8: Sample of Modified Shells Tentatively Identified as Knives or Scrapers

level of modification tends to be more suggestive of intentional retouch. Overall, most of these tools contain fractures that are not along natural growth planes and the modification is to such an extent that it gives them to appearance of a culturally modified, or retouched specimen. The second group of shells show evidence of drilling in the form of small holes along the posterior margins (Figure 4.9). While it is unclear what purpose these holes served, they do not appear to be related specifically to the function of shells as tools. The drilling of marine and freshwater shell is often associated with shell bead production, and these implements might represent some stage in bead production. This will be discussed further in Chapter 5.

In an effort to rule out the possibility that many of the Mussel Beach shell tool specimens were produced as the result of natural taphonomic processes, a series of experiments were conducted. Two species of freshwater shellfish, *Ellipsaria lineolate* (Butterfly Valve) and

Figure 4.9: Modified Shell with Evidence of Drill Holes. (Arrow Indicates Location of Drilled Area.)

Elliptio crassidens (Elephant ear), were selected for a series of controlled experiments. Both of these species occur regularly within the Mussel Beach collection and both are present within the purported tool assemblage. The mollusks used in these experiments were procured from the Cumberland River Aquatic Center with permission from the Tennessee Wildlife Resource Agency (TWRA). The specimens were harvested alive, but they had spent the majority of their lives within a tank. Because they were living outside of their natural environment, these shells were not exposed to the majority of the natural taphonomic processes that can affect shell morphology and appearance, including wave impacts, desiccation, and predation by other animals (Szabo and Koppel 2014).

Because it is likely that the use of shell as a tool source coincides with subsistence activities at Mussel Beach the first of the experiments sought to examine two different bivalve opening techniques, each of which relied on some form of direct or indirect heat. In light of the amount of shellfish utilized during the Middle Woodland occupations at Mussel Beach, mechanical or manual opening methods were not tested. Such opening techniques include cracking or perforating of individual shells using a wedge or levering tool. Mechanical techniques tend to result in non-patterned damage to the bivalve, including the crushing, cracking, and chipping of the shell, but more importantly they are also labor intensive and time consuming. Roasting, boiling, or steaming all have the potential to open hundreds of shells in the matter of minutes, which is considerably more efficient for the bulk processing of mollusks. Evidence at Mussel Beach, including the abundance of whole, non-burned bivalves, suggests bulk opening techniques, by way of steaming or boiling over indirect heat. The shells for these experiments were opened over indirect heat on heated coals and on an open grill. Each of these methods were effective, as they opened the shell and cooked the meat without severely comprising the structure or integrity of the shell, and that they required minimal amounts of time and physical energy. These opening techniques would likely to have been preferred over mechanical methods, because they would have allowed for other tasks to be performed simultaneously (King and Walker 2015). After opening, the mollusc shells were cleaned of their meat and remaining connective tissue, rinsed thoroughly in warm water, and assessed for any extraneous damage prior to any attempts to replicate tool form through various manufacturing techniques.

The next set of experiments conducted were designed simply to understand how shell fractured and which manufacturing techniques might have been employed to create the shell tools represented in the sample. The most basic technique that was utilized was a compressive force that was delivered to the highest point on the outer surface of shell, which was positioned flat on a hard surface (Figure 4.10). This simple technique, demonstrated that single strike direct

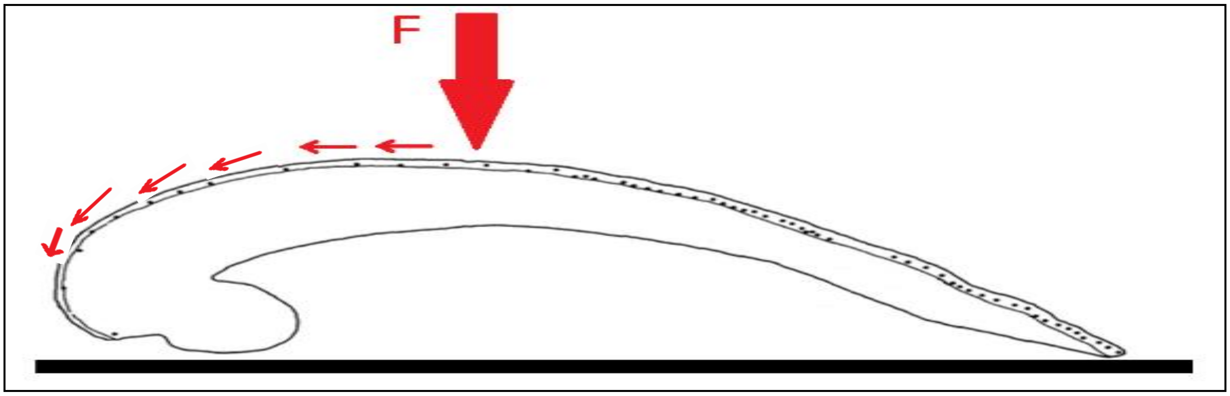


Figure 4.10: Image Showing the Location of Compressive Force Applied to the Bivalve During Single Strike Direct Percussion (Image from King and Walker 2015).

percussion was successful in fracturing shell when struck with considerable force. This technique resulted in complete fragmentation, or failure, of the shell (Figure 4.11). While each shell portion possessed considerably sharp edges that would have been suitable for cutting and scraping a variety of raw materials, the resulting fracture was not particulary desired. With this particular technological strategy it was not possible to direct the force in such a way that we had control over the fracture trajectory, however some of the resulting pieces do resemble specimens identified as those with a straight edge. While it took considerable force to shatter these specimens, it is premature to rule out natural external forces as being responsible for these types of fractures, and by association the purported tool types identified by their straight edges.

Additional experiments were conducted using a form of indirect percussion, wherein an intermediate tool, in this case a stone drill, was placed between the hammer stone and the objective shell piece. Instead of placing the shell on a flat surface a small rounded stone was positioned underneath the shell, which was also cushioned tighyl against the leg. The sudden, but substantial force applied to the shell did not result in the entire fragmentation of the bivalve,

Figure 4.11: Shell Fractures Resulting from Direct Strike Percussion on Exterior Bivalve Surface (Image from King and Walker 2015).

but was effective in removing desired portions of the shell. With this method we were able to control the modification of the bivalve, which resulted in the successful replication of several tools forms, including the square and “V” notched implements (Figure 4.12).

The final set of experiments sought to determine if technological strategies associated with the bifacial reduction of lithic artifacts were applicable to shell. Direct percussion, which can be undertaken with both a hard and soft hammer, is efficient in the initial stages of lithic reduction and can also be employed in the final shaping of a tool. Pressure flaking, as a reductive technique, is much more effective for the controlled removal of small flakes when sharpening tool edges or in the final trimming stages of bifacial reduction. The experiments demonstrated that a hammerstone was much more effective than the antler billet in reducing and shaping the thin outer edges of the bivalve shell. When struck with a small quartzite hammerstone, small flake-like pieces of shell, were removed from the shell edge, but the further

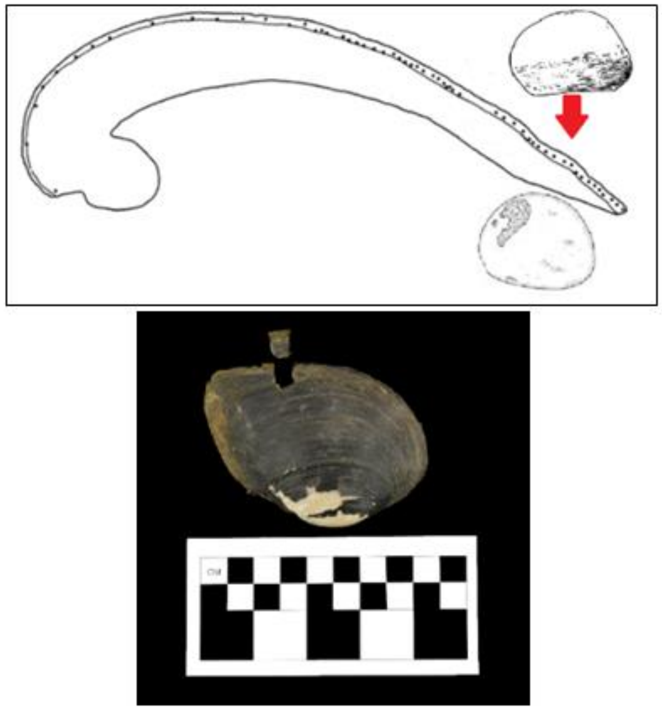


Figure 4.12: Shell Fractures from Indirect Percussion

the shell was penetrated the more difficult it became to achieve any modification. The same held true for pressure flaking, it was an effective strategy only on the thin outer margin of the shell, but became relatively ineffective nearer the thick umbo. We decided lastly to use the hammerstone on the interior and exterior shell edges in more of an aggressive abrasive manner. The combination of direct percussion and abrasion was much more successful in modifying the shell than pressure flaking and direct percussion alone, however we were unsuccessful in replicating any specific tool forms.

The experiments with shell tool reduction and manufacture closely mirror those of other scholars (Szabo et al. 2007; Szabo 2008; Szabo and Koppel 2014; Tyree 1998). Ethnographic studies among contemporary shell-using societies, and experimental research, demonstrate thatshell can be worked effectively using both direct and indirect percussion techniques, as well as other technological strategies, including grinding and freehand abrasion (Szabo et al. 2007; Szabo 2008; Szabo and Koppel 2014). These studies also found, however, that breakage patterns among different species of shell will vary, and that shell is much more affected by taphonomic processes, degradation, and weathering than lithic raw materials (Pryzwolnik 2003; Szabo 2008;)

In order to rule out that that the shell implements recovered from Mussel Beach were not the result of natural processes, it was important to consider the possible taphonomic processes affecting shells after both death and discard. It has been shown that immediately following the death of a shellfish, the organic components of the shell begin to break down and this can be exacerbated in warmer climates (Szabo 2008). Exposed to the natural elements, shell may become nacreous and flakey (Light 2002), and the texture chalky and brittle as the outer calcite layers decay (Masson 1988). Experiments with shell have shown that within just three days of the death of the animal the shell loses almost half its original strength in compression (Szabo 2008:130). With the loss of strength, shell does not fracture as predictably and has a tendency to shatter (Rosenthal1977:374). For these reasons, many scholars have suggested shells tools would have been manufactured from fresh specimens (O'Day and Keegan 2001; Masson 1988; ORosenthal 1977). It is also recognized that immediately after death, the outermost layer of a bivalve, or the periostracum, will begin to flake off, beginning at the umbo and extending outward.

Besides the natural degeneration of the shell after death, the two of the most common types of disturbances affecting shell deposits in middens include trampling by humans and animals, as well as scavenging activities. The shells from the Mussel Beach assemblage were determined to have been deposited quickly within middens and analyses of the shells by malacologists found very little evidence of scavenging activities. The amount of fractured shells in the overall invertebrate assemblage does suggest, however, at least some minor trampling. Experiments with lithic raw materials have demonstrated that any amount of trampling can result in damage to lithic assemblages, damage which often resembles usewear (Tringham et al. 1974; Penvy 2012; Rasic 2004). In order to see if trampling activities were responsible for the fracture patterns observed among the shell tools, and the localized patterns of wear on the dorsal surface of many shell tools, a sample of the unmodified bivalves (n = 7 elephant ear and n=3 butterfly valve) were left exposed to the natural elements for nearly two years. The shells were deposited in a compact dirt matrix and were subjected to rain, wind, periodic episodes of freezing and thawing. In addition to these natural processes, the shells were trampled on frequently. Trampling including stepping and stomping on the shells repeatedly for several minutes.

Although none of the shells suffered any fractures at the result of trampling and exposure experiments, differences were observed in the amount of shell degradation, particularly with regard to the removal of the periostracum for each individual specimen. In general, all of the elephant ear specimens (Figure 4.13) exhibited extensive flaking of the periostracum, although none of the shells exhibited the complete removal of this exterior layer. While the removal of the periostracum did begin at the umbo and extend outwards towards the ventral margin, the pattern of removal did not resemble any of the shell tool specimens from the Mussel Beach collection. There was, however, a considerable difference observed in removal of the periostracum for the butterfly valve specimens (Figure 4.14), in that each of the specimens retained almost all of their outer layer. The butterfly valve specimens did show evidence of periostracum thinning, but it did not flake off in the same manner as it did on the elephant ear specimens.

The preliminary results of the shell experiments have led me to believe that many of the

Figure 4.13: Elephant Ear Shells Showing Natural Degeneration from Exposure and Trampling Experiments

Figure 4.14: Butterfly Valve Shells Showing Partial Degeneration of the Periostracum from Exposure and Trampling Experiments

shell implements identified as tools were produced as the direct result of human modification, and were not produced at the result of natural taphonomic processes. In order to determine the exact nature of the tools, their function, and their roles within the overall technological system at Mussel Beach, it is necessary to examine the artifacts further and conduct usewear analyses. Unfortunately, the attempts to examine the shells under low-power magnification were unsuccessful. The vast majority of the shells recovered from the Mussel Beach site are in a state of severe degradedation; they have a chalky appearance, are extremely fragile, and appear to be fracturing naturally along growth planes. In such a fragile state, it is difficult to handle the artifacts, and there are also likely to be difficulties with tool preparation and handling associated with high-power analyses. Washing the shell tools, for example, may prove to be problematic, as the organic nature of the artifacts means that they cannot not be treated with chemicals or abrasives.

Currently, there is no standard procedure for cleaning shell tools, and this is ultimately because there has been so little experience in the usewear analysis of shell from the archaeological record. The degraded nature of the tools from the Mussel Beach collection might also make it difficult to mound the artifact for examination, and could result in damage to the artifact. As it stands, many of the modified shells are still tentatively considered to be expedient tools. Future work with the shell tool assemblage will focus on identifying shell specimens that would make good candidates for additional usewear analyses, and developing methods and analytical techniques necessary for preparing specimens for analysis. Additional experiments with fresh water shells are also necessary to fully understand the formation of edge damage on shell. Future analyses of the shell tools are necessary, however, as they are a relatively understudied component of the archaeological record in the Southeast.

4.2.4 Lithics

Lithic artifacts produced from various types of raw materials were recovered from each of the five temporal components at Mussel Beach. Located just below the escarpment of the Cumberland Plateau, the inhabitants of site 40MI70 has access to several geologic features filled with outcrops of high quality Mississippian, Fort Payne, Knox, and Saint Louis/Warsaw chert. Primary sources of chert are located just one to three miles from site in the cliffs along the Cumberland Escarpment as well as on low limestone ridges. Secondary chert sources were available in gravel deposits of the Tennessee River (Gregory et al. 2011: 363–364). All of the chert sources available are fine grained and of high knapping quality, and they occur in tan, gray, and black varieties, which can often make them difficult to distinguish from one another. Because of the inherent similarities between the chert, there was no attempt by Gregory et al. to formally delineate among chert types within the majority of the lithic assemblage (2011:364).

The lithic tools recovered from Mussel Beach were divided by Gregory et al. into the following categories for analysis and description: tools, debitage, and other. The analysis of the lithic assemblage was conducted by Danny Gregory using a standardized set of tool types defined in the New South Associates' laboratory manual. Lithic tools were initially classified as flaked-stone, ground stone, and other. Upon further analysis tools were placed into more specific technological categories based on similar morphological characteristics and perceived function (Table 4.20). The most common technological classes for the flaked-stone tools include bifaces, projectile points/knives, and scrapers. Additional classes of chipped-stone tools identified by New South included drills, spokeshaves, flake tools, and utilized flakes (Gregory et al. 2011:339-343). Attributes recorded on the flaked-stone tools included raw material type, size, weight, and presence of use-related wear. The ground stone artifacts consisted primarily of

Table 4.20: Lithic Tool Types Identified by Gregory et al. (2014) at Mussel Beach

Lithic Tool Type	**LA I**	**LA II**	**LA III**	**MW**	**LW**	**Mixed**	**Totals**
Abrader		1		2			3
Biface	7	20	45	17	2	22	113
Burin	1	1					2
Celt	2		1				1
Core		4	20	13	3	17	59
Drill		1		1	1	3	5
Flake-Retouched	2	2	13	5		8	31
Flake-Tool			1			2	3
Hammerstone	1	5	3	6		2	17
Hoe				3		2	5
Mano				2			2
Nutting Stone		1		1		1	3
Plummet Stone				1			1
Projectile Point/Knife	3	13	35	37	1	28	117
Scraper				2			2
Spokeshave			1				1
Unidentified Tool			1	1			2
Utilized Flake	2	2	1				5
Totals	**18**	**50**	**121**	**91**	**7**	**85**	**372**

(Table After Gregory et al. 2011:342-343) sandstone hoes. Stone tools classified as other included celts, cores, hammerstones, and nutting stones.

Of the total of 372 lithic tools recovered from Mussel Beach, 350 were identified by New South Associates as flaked stone, or retouched, tools. The vast majority of these tools came from the Late Archaic III and Middle Woodland occupations. Projectile points/knives (PP/K) and bifaces, found in various stages of manufacture and completeness, were the found to be the most common tool type recovered, followed by cores, retouched flakes, and hammerstones. Most tool types were recovered within each of the five temporal components, with the exception of certain ground stone artifacts, including hoes and manos, which were only found within Middle Woodland contexts.

From the total sample of PP/K's, 37 artifacts were identified as temporally diagnostic based on whole and proximal PP/K specimens. Thirty of these projectile points were derived from Late Archaic contexts. The only diagnostic PP/K artifact identified from the Late Archaic I component was a Benton Stemmed. Diagnostic projectile points from the Late Archaic II included Paris Island, Kays Stemmed, Ledbetter, Cotaco Creek, and Iddins Stemmed. Late Archaic III projectile points were identified as Coosa, Wade, and Bradley Spike. Several unspecified Late Archaic tool types were also recovered, and these include Allendale, Elora, and Small Savannah River. The remaining seven diagnostic artifacts included Copena Triangular, Nolichucky, and Baker's Creek from the Middle Woodland and a single Jack's Reef Pentagonal from the Late Woodland (Gregory et al. 2011:348-349).

Lithic debitage was by far the most abundant chipped stone artifact recovered from the Mussel Beach site (n=28,132). The debitage was analyzed by New South using a two-tiered approach that involved both a general artifact analysis and an in-depth lithic attribute analysis.

The general analysis, or mass analysis, was conducted all debitage specimens and the following attributes were recorded: raw material type, debitage category (flake, flake fragment, or angular debris), weight, and provenience (Gregory et al. 2011:339). Gregory et al. do note that the general debitage analysis suffered from sampling effects (2011:353). The frequencies of flake fragments among the debitage assemblage was higher than expected, however, this appears to be the result of both recent plow activities and secondary depositional events. The in-depth attribute, or individual flake analysis, was carried out on a 23 percent sample (n=6,523) of debitage that was derived from only those depositional contexts with intact temporal components (Table 4.21). While the four temporal contexts occupy the same location, debitage was recovered from a variety of feature and non-feature contexts, each of which represent different activities and site types (Gregory et al. 2011:355). A more detailed description of the methodological background for both mass and attribute analysis can be found in Chapter 5.

The sample selected for individual flake analysis by Gregory et al. included microdebitage processed through 0.25-inch screens as well as microdebitage from floatation samples (n=439) (Gregory et al. 2011). In total, 6,523 pieces of debitage were examined and 14 lithic attributes were recorded for each specimen. The attributes recorded included debitage type, raw material, raw material quality, size, weight, completeness, portion, dorsal cortex, platform remnant morphology, termination, retouch, usewear, and thermal alteration (Gregory et al. 2011:340). Specimens in which wear or use-related damaged was observed were only subject to macroscopic analyses, and were not analyzed under low or high power microscopy to determine use-related actions or materials worked. The next section provides a brief summary of the results of New South Associate’s debitage analysis and the resulting interpretations regarding lithic reduction strategies for each temporal component.

Table 4.19: Summary of Debitage Sample Selected for Attribute Analysis

Temporal Component	Provenience	Macrodebitage	Microdebitage	Total Sample
Late Archaic I	Block A, Excavation Units	503	271	**332**
Late Archaic II	Block A, Excavation Units, Feature 406	2,122	131	**3,603**
Late Archaic III	Block A, Excavation Units, Feature 425	3,572	31	**2,253**
Middle Woodland	Block A, Feature 383	326	6	**774**
Totals		**6,523**	**439**	**6,962**

(Table After Gregory et al. 2011:355)

The Late Archaic I occupation at Mussel Beach was interpreted as a logistic camp used primarily for early stage lithic reduction. This component contained a dense localized debitage deposit, with microdebitage averaging approximately 350 specimens per 100 liters and microdebitage 2,500 specimens per 100 liters (Gregory et al. 2011:383). The high density of debitage and microdebitage is believed to representative of intensive lithic reduction activities and the results of the attribute analysis suggests that occupants were engaged extensively in early stage core reduction. Debitage from the Late Archaic I exhibited high percentages of dorsal cortex, cortical platform remnants and a low percentage of retouched platform remnants (Gregory et al. 2011:383); characteristics traditionally associated with early stage reduction (Andrefksy 2012). Lithic reduction activities were similar during the Late Archaic II component, with a continued emphasis on early stage lithic reduction. A large percentage of debitage contained dorsal cortex, as well as a high percentage of flat platform remnants (Gregory et al. 384). The Late Archaic II sample also contained a higher frequency of flake fragments which suggests that the debitage was deposited on a living surface that was subjected to fragmentation as the result of trampling or secondary deposition (Gregory et al. 2011:384). The deposit of debitage in a seconday context might suggest a longer habitation, and the removal of unwanted debris from a habitation area.

The largest overall lithic assemblage at 40MI70 was recovered from the Late Archaic III component. The debitage assemblage from this occupation was consistent with both early and late stage core reduction. The nature of the debitage assemblage also provides evidence for the manufacture and maintenance of bifacial tools. Debitage specimens exhibited much less dorsal cortex and also the highest percentage of faceted, or prepared, platform remnants (Gregory et al. 384). Between each of the Late Archaic occupations there were no observable differences in raw material availability or quality, and no evidence to suggest that site function or primary subsistence activities changed (Gregory et al. 2011:384). Lithic reduction during the Middle Woodland, however, does show a change in activity as indicated by an emphasis on late stage reduction, bifacial production, and tool maintenance (Gregory et al. 2011:385). A large percentage of the debitage analyzed from the Middle Woodland occupation was primarily recovered from Feature 383, which has been identified as a refuse midden. Debitage from this feature contained high percentages of retouched platform remnants, a characteristic believed to be an indicator of resharpening activities (Gregory et al. 2011:385). The Middle Woodland sample also contained a high frequency of small size debitage and microdebitage, with larger specimens (over 4g or 4cm) underrepresented. Gregory et al. hypothesize that the lithic artifacts recovered from Feature 383 represent a secondary deposit of debitage that was likely swept up from a nearby living area (2011:385).

In addition to the lithic tools and debitage recovered from Mussel Beach there were two artifacts classified as “other”. Located in within a shell midden in Locus 1, excavators recovered a broken slate gorget (Figure 4.15) which dates to the Middle Woodland period. Items of personal adornment, like the slate gorget, are common within Middle Woodland contexts in the Southeast (Faulker 2002). The second artifact is a polished chert bead (Figure 4.16) recovered from an excavation unit in Block A. The bead, which dates to the Late Archaic I component, is cylindrical in shape with a longitudinal hole in the center. Polished beads are also common within many Southeastern sites during the Late Archaic period (Giliberti 1999). Items of personal adornment are important indicators of social identity, and they can be used to differentiate individuals within a community.

4.3 General Site Interpretation

The dense assemblage of artifacts and multiple excavated features from Mussel Beach allowed Gregory et al. to make several interpretations regarding the prehistoric occupations and behaviors occurring at site 40MI70 during each of the five temporal components (2011). This section provides a brief synthesis of those interpretations. It should be noted, that these interpretations may be subject to change once the results of the microwear analyses are quantified.

4.3.1 Late Archaic I

Based on the artifact assemblages, it was concluded that during Late Archaic I occupation (5,480 – 4,850 cal B.P.) the Mussel Beach site served primarily as a location for the procurement of raw materials and lithic reduction (Gregory et al. 2011:641). The greatest artifact assemblage from this component was debitage produced from locally available raw material. Although the lithic assemblage also contained a variety of chipped-stone and expedient-type tools, no diagnostic artifacts were recovered. Also absent from the Late Archiac I were features and faunal remains. A relatively small sample of archaeobotanical remains was recovered from the

Figure 4.15: Slate Gorget Recovered from Middle Woodland Cultural Component

Figure 4.16: Polished Stone Bead from Late Archaic I Component

Late Archaic I, however the sample was too small to determine the extent of plant use during this occupation (Gregory et al. 2011:641).

4.3.2 Late Archaic II

The Late Archaic II (4,700 – 3,890 cal. B.P.) contained a much more substantial cultural deposit, with larger artifact assemblages and a variety of intact features (Table 4.22). In total, fifteen features were identified from the Late Archaic II. The features, which were primarily clustered in Block A, included three hearths, three soil stains, and nine thermal pits (Gregory et al. 2011:646). Recovered within these features were the majority of the archaeobotanical remains associated with this occupation. The archaeobotanical sample from the Late Archaic II was quite large, and was dominated by nutshell, but also included a variety of locally available cultigens, fruits, and herbs (Gregory et al. 2011:645).

Similarly to the Late Archaic I, the Late Archaic II component contained a large assemblage of lithic artifacts, of which debitage was the most abundant. Lithic tools associated with this component were much more diverse in form, and included a variety of bifacial artifacts, non-diagnostic PP/K's, and diagnostic projectile points. The faunal assemblage recovered from the Late Archaic II was small and contained only vertebrate remains. Several of the faunal remains show evidence of butchering, but none of the specimens appear to have been burned, which suggests that cooking activities occurred outside of the excavation area or at a different location all together (Gregory et al. 2011:645). Based on the analyses of each cultural assemblage, Gregory et al. interpreted this component as a reused logistical campsite that served not only as a location for lithic procurement and reduction, but also for the bulk processing of mast resources and the butchering and processing of animals. The seasonality of both the plant and animal assemblages suggests that the site was visited year-round, with more substantial

Table 4.20: Summary of Features Associated with Late Archaic II Component

Late Archaic II Features					
Feature	**Feature Type**	**Location**	**Stratum**	**Calibrated Radiocarbon Age (years B.P.)**	**Excavated**
413	Thermal Pit	Midden Area 2	Iva	4,140 - 4,410	Yes
415	Thermal Pit	Midden Area 2	Iva		Yes
453	Hearth	Block A	Iva		Yes
496	Hearth	Block A	Iva	4,080-4,290	Yes
481	Soil Stain	Block A	Iva		Yes
497	Soil Stain	Block A	Iva		No
423	Thermal Pit	Block A	Iva	4,290 - 4,580	Yes
424	Thermal Pit	Block A	Iva	3,890 - 4,100	Yes
425	Thermal Pit	Block A	Iva		Yes
426	Thermal Pit	Block A	Iva		Yes
454	Thermal Pit	Block A	Iva		Yes
455	Thermal Pit	Block A	Iva		Yes
456	Thermal Pit	Block A	Iva	4,090 - 4,500	Yes
483	Hearth	Block A	Iva	4,240 - 4,700	Yes

(Table Adapted from Gregory et al. 2011:163-167) occupations in the summer and fall, and scattered short-term occupations in winter and early spring (Gregory et al. 2011:647).

4.3.3 Late Archaic III

The final Late Archaic component, Late Archaic III (2,940 – 2,340 cal. B.P.), contained the largest overall artifact assemblage at Mussel Beach. The lithic assemblage was dominated by debitage (n=10,574) produced from locally available chert. Additional chipped stone tools (n=121) included a small sample of non-diagnostic bifaces, projectile points, and cores. It is during the Late Archaic III occupation that ceramics were introduced into the artifact assemblage. While relatively large (n=986), most of the ceramics found were residuals fragments which were unidentifiable (n=634). The remaining sherds (n=352) varied in both surface treatment and temper. The assemblage was dominated by quartz-tempered fabric-impressed and limestone-tempered plain ceramics manufactured out of local clay (Gregory et al. 2011:650-651). Based on many of the ceramics recovered, Gregory et al. have identified the Late Archaic III as more of a transitional Early Woodland occupation (2011:649).

The Late Archaic III faunal assemblage contained only 206 vertebrate specimens, however invertebrates (n=56) appear to have become incorporated into the diet during this occupation. The archaeobotanical sample associated with the Late Archaic III indicates additional changes in subsistence practices. The incorporation of EAC cultigens, coupled with the relative decrease in mast resources, suggests a much greater reliance on gathered and cultivated plants (Gregory et al. 2011:653). The eight features (Table 4.23) identified from this cultural component included one cultural surface, two postholes, one refuse midden, one burned post, two thermal pits, and one storage pit (Gregory et al. 2011:653). Taken together, Gregory et al. have interpreted the Late Archaic III occupation as a reused, logistical campsite that saw

Table 4.23: Summary of Features Associated with Late Archaic III Component

Late Archaic III Features					
Feature	**Feature Type**	**Location**	**Stratum**	**Calibrated**	**Excavated**
406	Storage Pit	Block A	IV	2,350 - 2,620	Yes
394	Thermal Pit	Block A	IV	2,780 - 2,960	Yes
399	Post Hole	Block A	IV		Yes
416	Post Hole	Block A	IV		Yes
472	Burned Post	Locus 6	IV	2,360 - 2,730	Yes
248	Refuse Midden	Locus 6	IV	2,350 - 1,620	Yes
257	Cultural Surface	Trench 2	IV		Yes
377	Thermal Pit	Trench 2	IV		No

(Table After Gregory et al. 2011:163-167)

multiple short-term occupations throughout the year, and possibly some longer habitations that necessitated the construction of one or more structures and use of a refuse midden (2011:655).

4.3.4 Middle Woodland

The Middle Woodland at Mussel Beach represents the most extensive cultural occupation, and the areas associated with this component are spatially, functionally, and temporally patterned (Gregory et al. 2011:670). Radiocarbon dating identified two distinct temporal clusters associated with this temporal component. The earliest of these clusters dates to 1,700 – 2,100 cal. B.P. and is associated with five features, including four shell processing middens and a thermal pit. The later cluster, which dates between 1,200 – 1,500 cal. B.P., is associated with several domestic features, including a hearth, smudge pit, two earth ovens, and a large refuse midden (Gregory et al. 2011:656). At least three structures, all located in Locus 6, are associated with this cluster of dates. Structure 1 was identified as a winter house with a central hearth that contained almost one quarter of the Middle Woodland archaeobotanical assemblage, including nutshell, herbs, fruits, and EAC cultigens. Results of wood charcoal analysis from four post features within Structure 1, found that two features (Feature 438 and 439), were composed almost entirely of cane (Gregory et al. 2011:669). The Structures 2 and 3 may represent related structural features or remnants of previous building episodes (Gregory et al. 2011:666).

As a whole, the Middle Woodland component yielded the second largest artifact assemblage at Mussel Beach. The lithic assemblage contained 4,133 pieces of debitage and 93 chipped stone tools. A small assemblage of ground stone tools, including manos and hoes, were also recovered, indicating an increase in plant harvesting and processing activities (Gregory et al. 2011:657). Further evidence for an increase in plant-based activities is the large and diverse assemblage of archaeobotanical remains recovered from this temporal component. The recovery of large quantities of mast resources, EAC cultigens, fruits, herbs, and wild plants is suggestive of a subsistence economy based largely on cultivated and wild plants as well as locally available nuts.

The Middle Woodland faunal assemblage included 723 vertebrate specimens and 1686 invertebrates recovered primarily from shell processing middens and shell-filled pits. Shellfish gathering and processing appears to be an important activity within both Middle Woodland occupations. Shellfish were gathered in bulk and processed on site using several different opening techniques, including manual extraction, boiling, and steaming, and were deposited quickly after. A large sample of ceramic artifacts (n=1,143) were also recovered and 494 of the sherd assemblage identified as having a variety of temper types and surface treatments (Gregory et al. 2011:659). Gregory et al. noted a differential distribution of ceramics types between the earlier and later Middle Woodland occupations with simple stamped specimens more prevalent during the earlier occupation and complicated stamped more common during the latter (2011:659).

From the 96 features (Table 4.24) identified within this component, the site contained burned posts, postholes, two possible structural floors, one cache pit, one collared hearth, one cultural surface, two earth ovens, one refuse midden, five shell processing middens, one smudge pit, nine soil stains, three shell-filled pits, and three storage pits (Gregory et al. 2011:666). The earlier of the Middle Woodland occupations has been interpreted as a reused logistical campsite, wherein shellfish exploitation was the primary activity taking place. The latter occupation was interpreted as winter habitation site that may have extended into the spring (Gregory et al. 2011:672). The inhabitants of this latter occupation exploited a much wider range of local resources which they stored in pits, cooked in earth ovens, and later deposited in refuse middens. The archaeological assemblage suggests that the inhabitants invested in this location for both short term resource exploitation and long term habitation.

4.3.5 Late Woodland

Plowing activities severely affected the integrity of the Late Woodland component at Mussel Beach and resulted in some degree of mixing between components. Gregory et al. note that there were very few Late Woodland contexts that were not affected by modern disturbances (2011:675). The artifacts recovered and dated to this time period were meagre and were limited to only six cultural features. The features included four shell processing middens and two postholes (Gregory et al. 2011:673). The lithics artifacts associated with the Late Woodland included only 73 pieces of debitage and seven chipped stone tools. The ceramic assemblage was slightly larger, containing 250 sherds, of which 152 were identified by temper and surface treatment. The faunal assemblage was also small, containing 37 vertebrate specimens and 336

Table 4.21: Summary of Middle Woodland Features from 40MI70

Summary of Middle Woodland Features	
Feature Type	**Count**
Burned Post	30
Cache Pit	1
Clay Floor	2
Collared Hearth	1
Cultural Surface	1
Earth Oven	2
Post Hole	26
Pot Bust	1
Refuse Midden	1
Shell-Processing Midden	5
Smudge Pit	1
Soil Stain/Pit	9
Thermal Pit	10
Shell-filled Pit	3
Storage Pit	3
Total Features	**96**

(Table After Gregory et al. 2011:158)

invertebrates collected primarily from a shell-processing midden (Gregory et al. 2011:675-676). Because of the level of disturbance associated with the Late Woodland, interpretation of site activities, other than shellfish processing, could not be determined.

The Mussel Beach site was occupied in various capacities throughout the Late Archaic and Middle Woodland periods, serving as both a short-term logistical occupation as well as a more substantial habitation involving the construction of one or more structures. The exploitation of natural resources, including lithic raw materials, animals, plants, and shellfish varied throughout the site's occupational history. Between the Late Archaic and Woodland period the site saw an increased reliance cultivated plants and a substantial intensification of shellfish exploitation. Ethnographic accounts among historic and contemporary shellfishing societies document women as the primary collectors and processors of shellfish (May 1982; Meehan1975; Murdock and Provost 1973; Waselkov 1987). In many cases, shellfish collection was recorded to take place away from the home base at temporary camps that were frequented by dozens of women and children at different times throughout the year (Meehan 1975; Moss 1993). In addition to shellfish collection, women are often observed engaged in other activities including the gathering of plant materials for subsistence or economic purposes, and the harvesting of mast resources for future consumption (Claassen 1991). The use of shell tools at shellfish collection and processing locations may reflect the provisioning of other raw materials as well as the social and symbolic functional of shells among many hunting and gathering societies (Claassen 1991; Moss 1993).

If women were present during the Middle Woodland occupation and were heavily engaged in activities associated with shellfish procurement, gardening, and perishable material culture production, it is important to investigate more specifically the types of tools and tool kits that would have been associated with these activities. The lithic assemblage recovered from each temporal component at Mussel Beach offers an opportunity to not only address changes lithic use over time, but to test hypotheses regarding the use of flake tool technology in the processing of certain plants for use as raw materials for perishable technology. In Chapter 5 I describe the methods utilized in the identification of flake tools from the debitage assemblages in each temporal occupation at Mussel Beach. I define the flake tools based on specific morphological characteristics and degree of usewear, and attempt to look for patterns in flake tool selection by comparing non-tool debitage to those selected for use. In Chapter 5 I also present preliminary results of the low-power microscopic analysis.

Chapter 5: Technological and Low-power Analysis of the Mussel Beach Flake Tool Assemblage

The lithic assemblages recovered from each of the five cultural components at the Mussel Beach site consist of a variety of tool types, including a range of ground and chipped stone implements. While hafted bifaces, mainly projectile points/knives, were the most common type of chipped stone artifact identified at Mussel Beach, these artifacts were not of primary interest in this dissertation. There is an extensive array of literature which not only document stylistic and morphological changes in hafted bifaces, but show that hafted bifaces functioned as projectile points, butchering implements, and multipurpose tools. In-depth analyses of flake tools, which include a combination of technological and functional analyses, are less common. Flake tools, particularly those utilized without additional retouching or edge modification, may exhibit only minor macroscopic edge wear and require some level of magnification to identify and characterize wear patterns. The initial identification of only a few flake tools by New South Associates, is therefore not entirely surprising given that each individual piece of debitage from the Mussel Beach site was not examined closely for evidence of use.

In this chapter I discuss the methods used to identify additional flake tools within the debitage assemblages at Mussel Beach and describe the criteria used to distinguish utilized, or use-modified flakes, from non-utilized debitage. I provide an overview of the data collection process, providing descriptions of how and why certain attributes were recorded on each individual specimen. Included in this chapter is also a description of the typological classification scheme used to categorize flake tools into categories based on wear patterns and morphology. The simple classification scheme utilized in this dissertation was created specifically to characterize an assemblage of flake tools which ranged from minimally modified flakes to those with moderate to extensive retouch. The overall typological schema has been adapted from several different lithic classification typologies (Andrefksy 2005; Sullivan and Rozen 1989) and is tailored specifically to the Mussel Beach flake tool assemblage. In this section I also provide descriptions and summaries of flake tool types based morphological characteristics, size, weight, degree of edge angle, and raw material type. Lastly, I compare the flake tool assemblages from each temporal component looking for patterns and changes in flake tool use over time. Information related specifically to tool function, and the results of high-power microwear analysis, will be presented in Chapter 6.

5.1 The Macroscopic Identification of Flake Tools

Flakes, in general, are defined as conchoidally-fractured pieces of lithic material that were struck from a core or tool (Andrefsky 2005). Unmodified flakes are a primary component of debitage assemblages, and are often deposited at or very near their locus of origin within past cultural systems (Binford and Quimby 1963). Flakes can, however, also be used as blanks to be modified into formal or expedient tools. Human modification, in the form of the chipping or removal of flakes from a tool margin, can be the result of intentional retouching, it can occur unintentionally when a flake is used as a cutting or scraping tool, or when the flake is subjected to abrasive forces such as grinding or polishing (Odell 2003:64). Variability in flake tool morphology is typically determined by the functional requirements of the tool and the relationship to specific tasks. Tool variability is also affected by tool use-life and differences in raw material. In many instances, almost all margins on a flake can be utilized as either cutting or scraping edges, and it is not uncommon to find that several different places on a flake tool have been modified to varying degrees (Andrefsky 2005:79). The primary differences between flake tool types is usually determined by the extent of the edge damage or retouch (Andrefsky 2005).

As mentioned in Chapter 4, the initial analysis of the lithic assemblage by New South

Associates only resulted in the identification 39 flake tools. Many of these artifacts were identified during their general lithic analysis, a process often referred to as mass or aggregate analysis. Aggregate analysis is defined as a method that analyzes debitage using non-technological criteria in an effort to characterize entire assemblages based on a hierarchical classification scheme (Ahler 1989; Larson 2004; Sullivan and Rozen 1985). Mass analyses always begin with debitage assemblages being sorted by size in a series of nested screens, with each size category being further stratified by any number of criteria (i.e., raw material type, dorsal cortex, debitage completeness). Aggregate analyses are shown to be effective for analyzing relatively large debitage assemblages rather quickly, and have been used successfully to determine various production stages and in some cases reduction techniques (Andrefsky 2005; Carr and Bradbury 2004). Critiques of this approach, however, argue that it can be an unreliable method for detecting the technological orgins of flaking debris (Andrefsky 2007, 2009). Additional critiques find that it is not necessary the method that is flawed, but errors results from the analysts misapplication of the approach (Carr and Bradbury 2009). Despite these critiques, lithic analysts have shown interest in using size grade variables for understanding lithic production activies, but do so with an understanding that levels of interpretation can vary (Carr and Bradbury 2009). Lithic analyst Danny Gregory at New South conducted a mass analysis on all 28,132 debitage specimens from Mussel Beach which included standardized size grading as well as the recording of several attributes, including raw material type, debitage category (flake, flake fragment, or angular debris), and weight (Gregory et al. 2011).

The in-depth attribute analysis, also referred to as individual flake analysis, was conducted on a 23% sample (N=6,523) of the recovered debitage assemblage and involved the recording of 14 lithic attributes for each specimen. Some of these attributes included debitage type and general morphology, raw material type and quality, and evidence of modification or use wear (Gregory et al. 2012). Individual flake analysis examines the distribution of flake attribute(s) over an entire population, or assemblage, and is not necessarily confined to specific size classes (Andrefsky 2001:9). These attributes can be used to identify trends within a population with regards to specific technological strategies. Many analysts prefer to combine data from both individual flake and mass analyses, and studies have shown that combined analyses are often more reliable for stage-oriented interpretations (Bradbury 1998; Carr and Bradbury 2001; Magne 2001; Prentiss 2001).

Debitage analysis in general is recognized as being an integral part of lithic analysis. Because it is a relatively durable byproduct of tool manufacturing and maintenance activities, debitage provides direct evidence for understanding discrete episodes of stone tool production (Ahler 1989:85; Fish 1981:374). Analyses allow archaeologists to reconstruct technological behaviors related to the "production, use, transport and maintenance of stone tools" (Rasic 2004:114) and provide insight on site activities, land-use patterns, subsistence activities, and social organization (Carr and Bradbury 2001; Rasic 2004). It is also through debitage analyses that the majority of flake tools are recognized.

In order to identify additional flake tool specimens, and begin to categorize the flake tool assemblage from Mussel Beach, it was necessary to re-examine the entire debitage assemblage in such a way that each individual flake, flake fragment, and piece of shatter was examined for evidence of edge modification or retouch. For this initial step, all debitage measuring ¼ inch and greater, was examined macroscopically with the aid of a 10x hand lens and an illuminated 5x lens. Debitage, irrespective of condition or context, was examined for evidence of use related wear in the form of edge damage, crushing, or abrasion. Any specimen which exhibited fracture scars, regardless of pattern, location, or degree of invasiveness, was selected for additional analysis. Each of the flake tools identified by New South Associates was also re-examined, as were the collections of bifacially retouched tools. The reexamination of these tools resulted in the re-categorization of several artifacts, including many tools previously identified as retouched flakes and bifaces.

After the initial macroscopic examination of the entire lithic assemblage was complete, a total of 924 pieces of debitage were tentatively identified as having some form of edge modification and were thus pulled from the assemblage for additional analysis. The sample included a variety of flake types, including complete flakes, broken flakes, flake fragments, and pieces of shatter of various shapes and sizes. It should be noted that the debitage characterized as non-tool manufacturing debris was also subject to additional analyses in the form of an in-depth attribute analysis. While a sample of debitage (23%; n= 6,523) was previously examined by New South Associates, some of the raw data was not reported in the site report and therefore it was unclear if they were recorded during the previous analyses. In order to determine if flank blanks were selected from the debitage assemblage based on certain morphological or technological attributes, it was necessary to examine the debitage closely and record attributes which might have affected functional properties. As such, I selected a 25 % sample (n=6,959) of non-utilized debitage and the following flake attributes were recorded on each flake specimen: debitage type (i.e., complete, broken, fragment, shatter), weight (g), length (mm), width (mm), thickness (mm), flake termination (i.e., feather, hinge, step, overshot, irregular), percentage of dorsal cortex, platform type, dorsal scar count, raw material type, and evidence of thermal alteration. The debitage selected was a representative sample from each of the five cultural components and consisted of complete flakes, flake fragments, and angular shatter. Data collected on the non-utilized debitage can be found in Appendix A.

5.2 Data Collection Overview

The selection of flakes for use as tools was most likely based on a combination of the task to be completed and some aspect of the flake's morphology. The size, shape, and thickness of a flake, as well as the angle of flake edges, would have been important factors to consider when selecting flakes for certain activities. Complete flakes, broken flakes, and pieces of angular shatter each had the potential to be used as a tool. As previously stated, one of the goals of this analysis was to determine if flakes selected as tools were statistically distinguishable from non-utilized flakes, and also to determine if flakes were selected for certain tasks based on some combination of attributes. In order to make determinations regarding the functional utility of certain flake forms, it was necessary to record attributes on tools (Table 5.1) which related not only to flake morphology, but attributes which can be used to distinguish different types of lithic reduction activities associated with flake blank production.

Each specimen tentatively identified as having edge damage was thus subject to an in-depth attribute analysis regardless of size or state of completeness. In most individual flake analyses complete flakes are the primary unit of analysis, but in this case a wide variety of flake types showed evidence of edge damage. It should be noted that the purpose of the individual flake analysis was not intended to characterize flakes into tools types based on perceived function or to make inferences regarding reduction stages or specific technological strategies. It was, instead, a necessary step to be able to identify patterns in flake tool selection based on shared morphological characteristics or technical attributes. What follows are brief descriptions of the attributes and variables recorded for each individual flake tool.

Table 5.1: Attributes Recorded During Flake Tool Analysis

Catalog Data
1. Accession number
2. Field bag number
3. Box Number
Provenience Data
1. Horizontal location
2. Vertical location
3. Temporal component
Morphological Data
1. Flake type
a. Complete
b. Broken
c. Fragment
e. Shatter
f. Indeterminate
2. Raw material
a. Fort Payne
b. Knox Black
c. Knox Gray
d. Knox Porcelaneous
e. Bangor
f. St. Louis
g. Monteagle
h. Chalcedony
i. Thermally Altered
j. Quartzite
k. Unidentified
3. Flake tool dimensions
a. Length
b. Width
c. Thickness
d. Weight
Technological Data
1. Platform type
a. cortical
b. Flat
c. Faceted
d. Abraded
e. Crushed
2. Dorsal surface characteristics
a. Cortex percentage
b. Dorsal scar count
3. Ventral surface characteristics
a. Lip
b. Bulb of percussion
Low-power Magnification Data
1. Microfracture type
a. Scalar
b. Hinge
c. Step
d. Half-moon
e. Edge nibbling
2. Edge damage location
a. Ventral surface
b. Dorsal surface
c. Right or left lateral margin
d. Proximal or distal margin
3. Edge damage patterning
4. Fracture scar length
5. Length of worked edge
6. Working edge morphology
a. Straight
b. Concave
c. Convex
d. Pointed
7. Worked edge angle
a. < 20°
b. 20°
c. 30°
d. 40°
e. 50°
f. 60°
g. 70°
h. 80°

5.2.1 Catalog Data

While technological and morphological data were integral to the analysis of the flake tool assemblage, it was imperative that each specimen be cataloged for future analysis and curation. The following information was recorded on both data sheets and data tables:

- **Accession number**: each artifact was given a unique identifier with follows the format "40MI70-xxx". Flake tools previously identified by New South Associates were given new accession numbers which also followed this format.

- **Field Bag Number**: each specimen analyzed from Mussel Beach was identified from within a bag associated with specific provenience information.

- **Box Number**: the box number refers to the collection of artifacts excavated on a specific day by New South Associates.

5.2.2 Provenience Data

The provenience information was also recorded for each artifact examined. Provenience information includes an artifact's horizontal location at the site, the vertical location, and if possible specific temporal-cultural affiliation.

- **Horizontal Location**: information associated with an artifact's horizontal location include the following information: excavation block, excavation unit, feature number, trench number, midden area, and locus.
- **Vertical Location**: vertical location for artifacts are provided in two forms, the first are arbitrary levels which are recorded as depth measurements in centimeters below datum (cbd), and the second is the specific stratum number. The excavation of deposits by New South followed natural levels, which are defined as the various

stratum. The stratum describes a stratigraphic unit that is largely temporal, however this term also represents a depositional context, as it refers to the sediments that were deposited roughly throughout the span of time encompassing that temporal component (Gregory et al. 2011).

- **Temporal Component**: as noted in chapter 4, cultural affiliation or temporal component was established using temporally diagnostic artifacts, radiometric dates, and 19 Accelerator Mass Spectrometry dates.

5.2.3 Morphological Data

The attributes recorded on each specimen included traditional debitage characteristics as well as attributes used to differentiate reduction strategies. On their own, many attributes convey very little information, however, when combined they provide important information related to flank blank production, stages of reduction, and ultimately tool selection based on specific manufacturing and functional characteristics. Included below are brief descriptions of the morphological attributes recorded on each individual flake tool specimen.

Flake Type and Condition:

All of the debitage from Mussel Beach had previously been placed into categories by New South Associates based on debitage type and relative condition of the artifact when it entered the archaeological record. The condition of debitage refers more specifically to the completeness of the artifact. In most cases, I found these categories to be satisfactory. However, when making a determination regarding debitage type, I tend to refer to Sullivan and Rozen's interpretation-free model (SRT) (Sullivan and Rozen 1985), which was not always in agreement with New South's typology. The SRT model, as applied in this dissertation, was utilized primarily as a means to identify flakes by condition, and was not intended to be used as a way to understand relationships between flake condition and technological strategies. The latter required the addition of other analytical techniques for which the results are intended to produce meaningful technological information. While the SRT model has been subject to multiple critiques (see Amick and Mauldin 1989; Close 2006; Ensor and Roemer 1989; Prentiss and Romanski 1989), particularly for the emphasis on "meaning-free" interpretations, it provides an effective and relatively quick method for categorizing debitage into mutually exclusive categories based on the following three dimensions of variability: 1.) presence of a single interior surface; 2.) presence of a striking platform; and 3.) intact lateral margins. Sullivan and Rosen's (1985:759) debitage categories include complete flakes, broken flakes, flake fragments, and debris (Figure 5.1). In order to categorize flake tools that did not fit comfortably into any one of the previous groups, it was necessary to include a fifth category, referred to herein as "indeterminate".

- **Complete flakes:** specimens which contain a striking platform, have a discernible dorsal and ventral surface, and retain intact lateral margins. Complete flakes also contain distal margins with intact terminations. Termination types, or the character of the distal end, are recorded as: feather, step, hinge, plunging/overshot, and irregular.
- **Broken flakes:** specimens which retain a striking platform, but lack intact flake margins. Broken flakes almost always terminate in abrupt step fractures.
- **Flake fragments**: specimens which have discernible dorsal and ventral surfaces, but lack both striking platforms and intact margins are typically referred to as flake fragments. Flake fragments tend to consist of medial and distal flake portions.

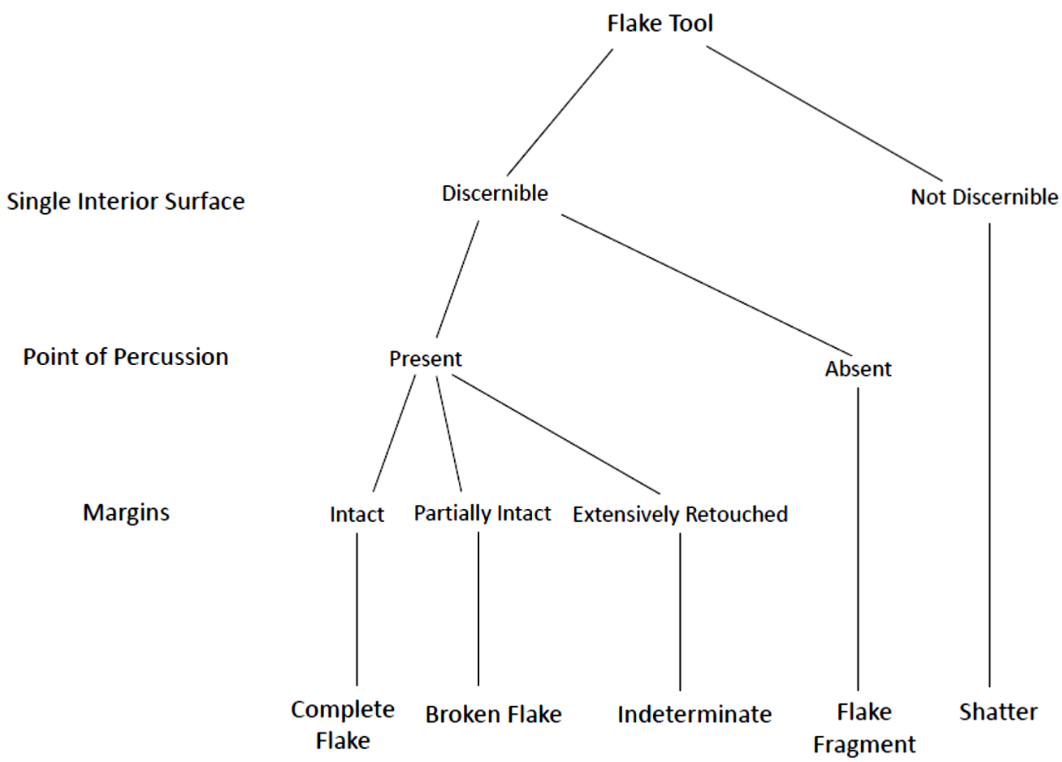


Figure 5.1: Technological Attribute Key Used to Define Flake Tool Type and Condition. Key Adapted from Sullivan and Rozen 1985:759.

- **Debris:** according to Sullivan and Rozen (1985), debris refers to pieces of angular shatter.
- **Indeterminate flakes:** this category include flakes which have been retouched to the point where the specimens exhibit very few flake characteristics.

It should be noted that this categorization of flakes by type and condition does not reflect technological categories associated with tool function. Flake condition instead may reflect different core reduction strategies and can thus be used to determine flank blank production activities. Flakes detached from unprepared cores, for example, tend to be fragmented with few complete flakes and more proximal fragments (Prentiss 2001). Flakes struck from prepared cores, in contrast, tend to be complete with intact margins and distal terminations. Flake condition and termination type also reveal information about the kinds of force used to detach flakes from cores (Andrefsky 2005). Complete flakes, for example, are more commonly produced as the result of hard-hammer core reduction, particularly on prepared cores (Prentiss 2011). Flake condition and flake type can also be indicators of the various post-depositional processes which affect artifacts and site formation. Flake condition alone, however, is not enough to make interpretations regarding specific types of reduction activities, and should therefore be combined with other flake attributes in order to better understand flank blank production.

In addition to artifact condition, flake tools were assessed to determine raw material type. As mentioned in Chapter 4, there were a variety of raw materials available within close proximity to the Mussel Beach Site, and many of the chipped stone tools were manufactured from locally sourced cherts, including several varieties of siliceous and cherty Fort Payne and Knox Chert, Monteagle, St. Louis, and Bangor, as well as lesser quality varieties of quartzite and chalcedony (Gregory et al. 2011). These chert types are mostly of a higher quality and are considered to be desirable raw materials for tool manufacture. There are major differences, however, in terms of brittleness and grain size of the raw materials, as well as nodule size. Fracture mechanics and reduction strategies would have been predicated on both the size of the materials available and their internal structure, and would certainly have influenced technological decisions by tool makers.

While I made a concerted effort to identify specific raw material types through the visual assessments of the artifacts, it was often difficult to differentiate between the gray and black varieties of Monteagle, Bangor, and St. Louis cherts. This was not surprising, however, given that they are part of the same Mississippian formations and in many locations are often not separated by layers of sandstone or shale (Milici et al. 1979; Thomas 1979). As a result, many geologists have classified these raw materials as Monteagle-Bangor undifferentiated (Thomas 1979). Raw material identifications were made based on the resemblance of raw materials to samples available in the comparative lithic collection at the University of Tennessee's Archaeological Research Laboratory (ARL) and raw material samples collected from within the Tennessee River Valley in the vicinity of the Mussel Beach site. Despite efforts to identify all raw material types, there were several varieties of unidentifiable stone.

One factor which affected the identification of raw material type on many artifacts was the heat-treating of the raw materials prior to flake blank production. The thermal alteration of both fine and coarse-grained siliceous chert is well documented in the ethnographic and archaeological record throughout North America. When deliberately subjected to heat many types of chert show not only marked changes in color and a noticeable luster (Rick and Chappell 1983), but also exhibit considerable changes in mechanical properties associated with the restructuring and possible melting of intercrystalline impurities (Crabtree and Butler 1964; Domanski and Webb 1992; Rick and Chappell 1983). Experiments with thermally altered cherts show that if treated correctly, the resulting raw material will have an improved flaking quality and lower fracture strength. Lower fracture strength allows for the removal of longer flakes with lighter load applications. Flakes detached from heat treated cherts also tend to have much sharper edges, are removed with fewer termination errors (Price et al. 1982:467; Purdy and Brooks 1971), and tend to break less during manufacture than untreated raw materials (Crabtree and Butler 1964; Rick and Chappell 1983).

The property changes associated with heat treating, however, will vary depending upon the raw material, more specifically the texture or degree of crystallization of the chert. Experiments with heat treating have found that not all materials heat treat the same, which can make the process unpredictable and can also increase the risk of tool failure. If not heat treated correctly, chert may develop heat fractures which ultimately render the raw material unusable (Purdy 1974; Rick 1978). While there are considerable advantages associated with heat treating chert, this process results in the physical and chemical transformation of raw materials and many of the changes in stone properties are not always beneficial. Thermal alteration has been shown, for example, to decrease the overall durability of a tool's working edge. This results in an increase in edge failure in the form of crushing, chipping, and dulling (Rick 1978). In general, heat treated edges are sharper, but much less durable and therefore not sufficient for stressful or heavy duty tasks (Rick and Chappell 1983). Thermally altered flake tools with their sharp edges would be suitable for tasks associated with the cutting or sawing of soft materials, but would probably be less efficient for heavy scraping tasks, as the risk of edge failure is greater. Very few flake tools recovered from Mussel Beach appear to have been thermally altered, which suggests that the raw material available would not have benefited greatly from this process.

Flake Tool Dimensions:

In addition to recording the condition of each flake tool, size dimensions were also measured on each specimen. All measurements were taken using Mitutoyo 6" digital sliding calipers and were recorded to the nearest 0.01 mm. Weight was also recorded for each specimen to the nearest 0.01 gram using a Scout Pro digital scale with measurement up to 200 grams.

- **Length:** Maximum length measurements were achieved using the long axis method approach (Dogandžić et al. 2015). On flake tools, maximum length measurements were taken from the point of percussion to the farthest distal end of the flake.

Measurements on flakes missing striking platforms were taken on the long axis from the most proximal end of the flake to the most distal. Measurements were recorded to the nearest 0.01 mm using sliding digital calipers.

- **Width:** Flake tool width was measured first at the longitudinal midpoint of the length axis to the nearest 0.01mm. Measurements were taken perpendicular to the point of percussion or the proximal end of the flake using sliding calipers. If this measurement was not found to be maximum width, a maximum width measurement was recorded.
- **Thickness:** Maximum flake thickness was also recorded for each flake tool away from the bulb of force. Measurements were recorded at the longitudinal midpoint of the implement to the nearest 0.01 mm.

Size characteristics of flakes are often thought to be good indicators of reduction trajectories and specific reduction types. Flake size may also have influenced tool selection for different tasks by individual tool users, and may therefore to be used to reveal relationships between tool function and flake morphology. Flake size will be assessed in conjunction will tool function to look for patterns in flake selection.

5.2.4 Technological Data

Additional attributes recorded on each potential flake tool specimen were those known to be associated with methods of production or stages of reduction. These attributes included: striking platform characteristics (i.e., flat, cortical, faceted, abraded), dorsal surface characteristics (i.e., cortex, scar count), and ventral surface characteristics (i.e., lip, bulb of force).

Platform Characteristics:

The striking platform, or point of percussion on a flake, is often analyzed and measured based on specific research questions. Variability in platform size, shape, and degree of preparation is believed to relate to various production techniques, including the kind of technology used, as well as stages of tool production, and size and type of the objective piece (Andrefsky 2005; Callahan 1979; Dibble 1997; Magne and Pokotylo 1981; Odell 1989:185; Whittaker 1994). Striking platform characteristics, however, are often difficult to measure consistently and with accuracy (Andrefsky 2001, 2005; Gnaden and Holdaway 1998). The striking platform characteristics measured for this dissertation follow those outlined by Andrefksy (2005).

- **Platform Type:** Striking platform type, and degree of platform preparation, is indicative of the preconditioning of cores prior to flake blank removal (Wilmsen 1970:14) and may signify the toolmakers desire for flakes with specific morphological characteristics. Platforms can be left unmodified, they can be prepared through abrasive forces, such as rubbing, grinding, and crushing, or they can be produced through the removal of small flakes (Andrefsky 2005:94). While there is the potential for an infinite number of striking platform types, I opted to use a simplified striking platform typology that included 5 primary platform types: cortical, flat, faceted, abraded, and crushed. Specimens missing striking platforms were also noted.
    - **Cortical:** Platforms characterized as cortical are those which contain an unmodified cortical surface (Andrefsky 2005:94). The presence of cortex on the striking platform often indicates that the flake was removed during early

stage reduction activities and also that the platform was not prepared in any way prior to the detachment of the flake.

- **<u>Flat</u>:** Flat striking platforms are those with smooth surfaces which lack flake scars and do not appear to have been modified prior to flake removal. Flat striking platforms may be completely flat, or they may be concave or convex in shape. Andrefsky (2005:95) notes that debitage with flat platforms tend to be removed from unidirectional cores, and typically do not result from bifacial reduction activities.
- **<u>Faceted</u>:** Faceted striking platforms usually exhibit surfaces with multiple flake scars that were detached as part of the platform preparation process. Flakes which exhibit multiple facets and show evidence of extensive preparation were found to be associated with bifacial reduction (Bradbury and Carr 1995; Whittaker and Kaldahl 2001:54). Andrefsky (2005:96-97) defined faceted platforms as "complex" platform types.
- **<u>Abraded/Ground</u>:** Flakes with striking platforms that are neither flat nor complex typically show evidence of heavy abrasion. Abraded or ground platforms tend to be quite thin and are believed be indicative of final stage lithic reduction (Andrefsky 2005). Platform abrasion suggests a greater degree of core preparation which makes for more precise detachment of flakes during the latter stages of bifacial reduction.
- **<u>Crushed</u>:** Striking platforms which exhibit extensive shattering or evidence of battering are classified as crushed. Crushed platforms generally consist of areas with multiple overlapping step-terminated fracture scars that exhibit no

patterning and have been battered beyond recognition. While bifacial knapping can produce crushed platforms (Whittaker and Kaldahl 2001:54), they are often found of flakes which have been detached using bipolar reduction techniques (see Ahler and Christensen 1983:187; Andrefksy 1994, 2005; Kobayashi 1975; Kooyman 2000; Shott 1989. 1999). Crushed platforms can, however, also be the result of manufacturing errors and may also be related to raw material quality.

Striking platform characteristics can be used to determine if flake blanks were detached from unidirectional, amorphous, or bifacial cores. These characteristics can also be used as evidence of core preparation, which may permit inferences regarding tool maker intent. Evidence for core preparation, for example, is likely to be evident when flakes of a particular shape or size were desired for use in a particular task.

Dorsal Surface Characteristics:

The dorsal, or exterior surface of a flake, represents the surface of the flake that was originally part of the outer face of the core. Many dorsal surface characteristics can be assessed to understand flake blank production and determine lithic reduction stages.

- **Dorsal Cortex:** Flakes detached during early stages of core reduction may contain dorsal surfaces covered with cortex. Cortex is essentially the weathered outer surface of lithic raw material (Kooyman 2000:15) that results from either the chemical or mechanical weathering of the stone's exterior surface (Andrefsky 2005:103). Most cherts that undergo chemical weathering exhibit cortex that is chalky in texture, while cherts that have been subjected to mechanical process contain cortex that is smooth or polished in appearance (Andrefky 2005). The amount of cortex present on the dorsal surface of a flake often correlates with reduction stages, as cortical flakes tend to be the first removed in the reduction sequence (Amick and Mauldin 1989; Andrefsky 2005; Magne and Pokotylo 1981). I recorded this variable as present or absent, and also attempted to express the amount of dorsal cortex using ordinal scale ranking for cortical values. Following Andrefsky (2005), I used a four rank scale, wherein the value of "3" represented 100% dorsal cortex, the value of "2" represented less than 100% but greater than 50%, the value of "1" represented anything less than 50% cortex, and the value of "0" indicated that the surface of completely free of cortex.

- **Dorsal Scar Count:** The dorsal surface of flakes may contain flake scars that were the result of the previous removal of flakes when the blank was still attached to the core. Dorsal scar counts may be used to determine the sequence of core reduction, and dorsal scar orientation may reveal the type of core reduced (Andrefsky 2005; Johnson 1989; Magne 1985). Fewer flake scars present on a flakes dorsal surface suggests that the flake was detached during the earliest stages of reduction, while flakes with numerous dorsal flake scars tend to be those detached during late stage reduction (MacDonald 1994). While this relationship has been demonstrating experimentally, many small late stage finishing flakes will exhibit very few flake scars or evidence for previous removals. This variable was also recorded using a four-value ordinal scale, wherein the value of "0" indicated either 100% dorsal cortex or no previous flake removals, the value of "1" was given to flakes with 1-2 flake scars, the value of "2" was assigned to flakes with 3-5 flake scars, and the value of “3” was assigned to flakes with 6 or more previous flake removals.

The characteristics of the dorsal surface of flake tools provides important information regarding flake blank production, but they may also be useful when attempting to understand flake tool selection. The presence of cortex on some flake implements, for example, may have served as a form of natural backing for tool prehension and thus would have been more desirable over flakes with little to no cortex that may have required edge blunting or retouching for handling.

Ventral Surface Characteristics:

The interior, or ventral surface of a flake, is the surface of the detached piece that has broken away from the core or objective piece (Andrefsky 2005:17; Kooyman 2000:13). The ventral surface of a flake is typically smooth and when unmodified, exhibits no previous flake removals. Features located on the ventral surface of a flake are generally good indicators of reduction technology, which by proxy may reveal information about stage of reduction. The variables recorded on the ventral surface of flake tools are those which are most often used to determine type of hammer used to detach flakes.

- **Lip:** Located just below the striking platform, and above the bulb of force, is a small protrusion known as a lip. This particular feature is believed to form on flakes that were detached from cores using direct soft hammer percussion. This variable was recorded as either present or absent.
- **Bulb of Force/Percussion:** The bulb of percussion is defined as a cone-shaped bulge distal to the striking platform on conchodial flakes (Kooyman 2000:13). This variable was recorded as being present or absent, and was also recorded as being slight, medium, or large.

Many researchers believe that the size of the bulb of force is related directly to the type of hammer used to detach the flake (Crabtree 1972), while others have argued that the formation of the bulb of percussion is related to the angle of applied force (Andrefsky 2005:20). While there may not be a close relationship between flake blank selection and ventral surface characteristics, it is important to understand how flakes were detached from objective pieces and which type of objective piece they originated from.

All of the information gathered from the morphological and technological analyses will be used to assess the degree of core preparation and core type. Prepared cores again signify a predetermination of flake form, which may indicate flake blanks of a particular size or shape were deliberately detached for use as tools. The morphological and technological data will also be used to look for patterns in flake selection related to specific manufacturing and functional characteristics.

In addition to conducting in-depth attribute analysis on each of the purported flake tools, it was also imperative that each specimen be examined to determine if the damage or wear present was cultural (i.e., modified through either use or intentional retouch), or if the damage was produced during lithic reduction activities or after deposition. For this step, all flake specimens were examined microscopically, as post-depositional processes, including trampling, chemical and mechanical weathering, excavation and curation methods, and various cleaning techniques can produce edge damage that resembles use-related wear and intentional retouch, thus resulting in the misinterpretation of artifacts (Grace 1996; Grace et al. 1985; Plisson and Mauger 1988; Levi-Sala 1986, 1996; Tringham et al. 1974). By taking into account all of the cultural and non-cultural processes which can affect lithic artifacts before and after deposition, I felt confident that the artifacts identified as tools were in-fact utilized as such.

5.3 Low Power Analysis and the Microscopic Identification of Flake Tools

Archaeologists have employed a wide range of techniques and theoretical approaches to understand and characterize lithic assemblages. More than a century ago, lithic analysts were concerned with determining whether or not artifacts were of cultural origin, how stone tools were manufactured, how the form and function of tools evolved through time, and how certain attributes could be used to establish chronology or cultural affiliation (Holmes 1894, Henry and Odell 1989, Yerkes and Kardulias 1993). In order to more accurately characterize tools based on use-related edge damage, it has become necessary to develop analytical methods based largely on an experimental framework with definable variables. It is only within the last three decades that archaeologists developed the principle methods used for interpreting the function of stone tools. This analytical method is known by a variety of other names, including edge-wear analysis, use-wear analysis, and traceology.

Prior to the development of functional analyses, tool function was inferred based on morphological characteristics, or by way of ethnographic analogy; wherein observations of stone tool use among contemporary cultures were used for comparative purposes to identify and classify prehistoric stone tools (Andrefsky 2005; Bindord 1978; Kamminga 1982; Rots and Williamson 2004; Weedman 2010). While ethnographic observations have proven useful, there are limitations in its application to archaeological assemblages. However, this does not mean that ethnographic observations cannot provide information which can be used to deduce the function of prehistoric stone tools. Ethnographic and ethnohistoric accounts provide opportunities to gain knowledge on technological and functional aspects of stone tools and the various activities in which they were engaged. Ethnographic observations can also be used to develop tests or problem-oriented experiments for archaeological materials. Developments in microwear methods and techniques have, however, made it possible to reconstruct, more accurately, the use-life of lithic artifacts and establish their role in various activities occurring at archaeological sites.

5.3.1 The History and Development of Low-Power Microwear Analysis

Russian born archaeologist, Sergei A. Semenov, revolutionized the study of lithic artifacts when he developed methods for analyzing tools that combined programs of experimental usewear with the examination of chipped stone tools under low-power magnification (Yerkes and Kardulias 1994:100). In 1934, Semenov (1964) began an experimental program that carefully documented different kinds of wear on tool surfaces. He was one of the first lithic analysts to not only explicitly define different kinds of microwear, but record the wear through magnified photographs (Tringham et al. 1974:175). Low-power magnification traditionally utilizes a stereomicroscope, with magnifications ranging from 5x to 60x. It is used to observe edge damage and diagnostic fractures, including microfractures or flakes scars, and in some cases linear striations. Differences in flake scar form and distribution, and striation orientation, were found to correlate with the relative hardness of material worked and work action (e.g., longitudinal or transverse action). The English translation of Semenov's seminal work, *Prehistoric Technology,* was published in 1964 and became the foundation on which many American archaeologists have modeled functional analyses of lithic artifacts (Ahler 1971; Gould 1980; Odell and Odell-Vereecken 1980; Tringham et al 1974).

The next significant development in usewear methodology was introduced by Lawrence Keeley in the 1970's. Utilizing a higher level of magnification, Keeley (1980) found that he was able to achieve much greater resolution of striations and polishes present on tool surfaces. The primary goals of microwear studies, as stated by Keeley (1980) were to determine the function of individual artifacts and "obtain as complete a picture as possible of the total uses represented on implements" from the archaeological record (1980:1). This new high-power approach examined artifacts under incident light at magnifications between 100x and 500x (Keeley 1974; 1980), which enables analysts to observe, in much greater detail, morphology and textual variation of polish and striations (Keeley 1980; Yerkes and Kardulias 1994). By documenting the types of edge wear that resulted from experimental use, and comparing it with damage present on archaeological samples, Keeley was able to determine the relative hardness of the material worked, and could also infer the specific materials on which the tool was used (e.g. bone, hide, wood, flesh, plant). This approach is concerned primarily with the distinctive micropolishes which develop on tool surfaces as the result of use. Following Keeley, researchers have verified many of his observations and elaborated on the various descriptions of wear traces (Yerkes and Kardulias 1994). Analysts continue to develop methodologies focusing on experimental studies (see Hays et al. 2015; Kononenku et al. 2015; Odell and Cowan 1986; Shea 2007; Smallwood 2015), the identification and quantification of wear (Grace et al. 1986), and more recently wear damage on non-lithic artifacts including bone and shell (Cuenca et al. 2014; Cuenca et al. 2010; Lammers-Keijsers 2007; Lombard 2005; Lombard and Wadley 2009; Stone 2001; Wadley et al. 2004; Van Gijn and Lammers-Keijsers 2010). Additional information specific to the high-power approach will be discussed in Chapter 6.

In general, the low-power microscopic approach is thought to be a reliable method for characterizing tools based on functional information and morphological characteristics (Kamminga 1982; Odell 1975; Odell and Odell-Vereecken 1980:119). The low-power approach can be advantageous in that it requires minimal specimen preparation, which enables analysts to sort and examine much larger samples in a relatively quick manner. Stereomicroscopes are also fairly inexpensive compared to the metallurgical incident light microscopes used for high power analysis (Olausson 1990; Yerkes and Kardulias 1994). Drawbacks to this approach, however, are that it is not possible to make more specific inferences regarding materials worked beyond that of the relative hardness of the raw material.

5.3.2 Edge Damage Morphology

Interpreting the function of stone tools and differentiating between edge damage produced as the result of natural processes or use-related activities depends heavily on being able to recognize unique wear patterns that form during use. The usewear and edge damage produced on the active edge of stone tools generally falls into five distinct categories: microfractures, striations, rounding, micropolishes, and residues. The formation of each is dependent on a number of variables, including differential friction and resistance of material worked, hardness and elasticity of both the raw materials and worked materials, duration of use, edge angle and edge morphology, and the amount of applied pressure (Keely 1989; Odell 1982; Vaughn 1985). Observable differences in the morphology of each category of wear help analysts determine the nature of materials being worked and the way in which the tool was used. Of the five types of wear mentioned, I consider only microfractures in this chapter, because they are the only type of wear that are readily visible under low-power magnification.

In the next section I describe the types of microfractures that can form on a tool's edge during use and discuss the types of wear patterns often associated with longitudinal (e.g. cutting or sawing) and transverse actions (e.g. scraping, whittling, or graving). I also discuss the microfractures that develop from prehension (e.g. hafting or holding) and those that can form as the result of natural or post-depositional processes. I also describe the difference between the formation of microfractures that form as the result of post-depositional processes and manufacturing activities. Detailed discussions and description of the formation and morphology of polish, striations, and edge rounding can be found in Chapter 6, as are the functional interpretations of the flake tools based on the combined low and higher power analyses.

Microfractures:

Of the five types of wear that develop during a tool's uselife, microfractures are typically the first to be identified and are perhaps the easiest to be quantified. This is not only because they can be observed macroscopically, but they are often the most ubiquitous and frequently occurring form of edge modification. Microfractures consist of "cavities or negative flake scars" on a tools edge that are left behind as a result sustained friction between the active part of a tool and the material worked (Shea 1992). Edge damage, in the form of small fracture scars, can be observed during the initial macroscopic investigation of a tool's edge, but a more thorough examination is performed under low-power magnification between 10x and 40x. The most comprehensive and detailed quantification of microfracture types come from Kooyman (1985), Odell and Odell-Vereecken (1980), Tringham et al. (1974) and Vaughn (1981). Fractures scars are most often characterized according to their size, shape, depth and outline of flake scars, distal terminations, as well as their distribution along a tool's edge (Keeley 1980; Vaughn 1981). Fracture scars are traditionally recorded as feather, scalar, half-moon, hinge, and step (Figure 5.2). In some instances, the fractures are extremely minute and indiscriminant and can only be described as edge nibbling. Irregular types of fractures scars including triangular, quadrangular, and trapezoidal have also been record by microwear specialists (Marreiros et al. 2015:13), but are not utilized in this study. In order to be consistent, fracture scars observed on artifacts from Mussel Beach and the experimental specimens are described as scalar, half-moon, hinge, and step (Figure 5.3). When applicable, edge nibbling may also be recorded.

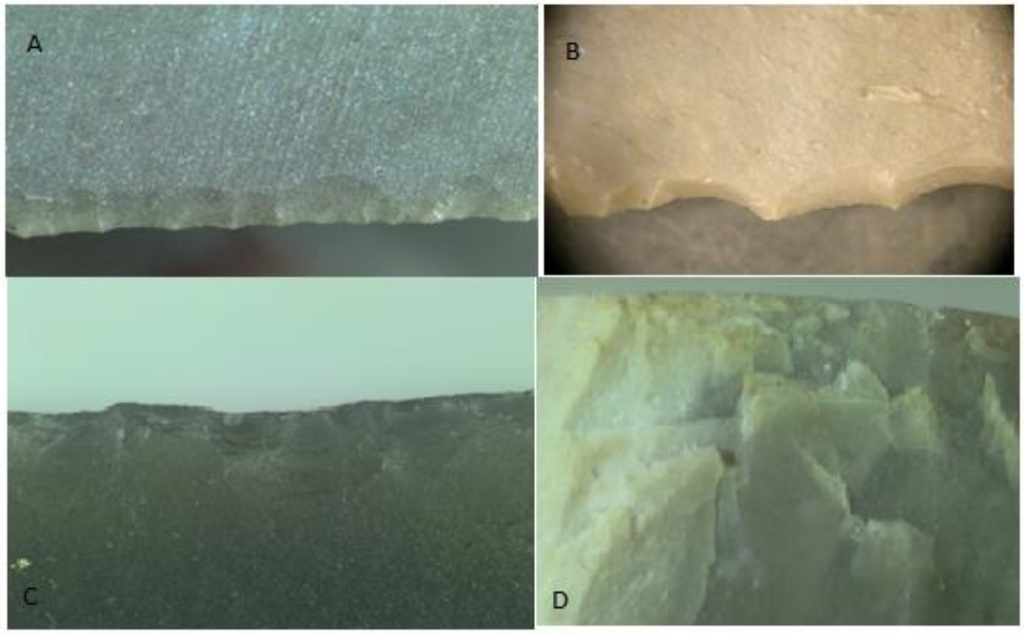


Figure 5.2: Microfractures (A)Scalar; (B) Half-moon; (C) Hinge; (D) Step Fractures

- **<u>Scalar</u>:** Scalar fracture scars are those characterized by feathered terminations, wherein the flakes detached become gradually thinner until the distal end is reached (Keely 1980; Kooyman 2000:19)
- **<u>Half-moon</u>:** Half-moon fractures scars are characterized as crescent-shaped breakages (Keeley 1980:25) which can often resemble serrated edges.
- **<u>Hinge</u>:** Hinge fracture scars are defined as upward curving terminations, wherein the distal end of the flakes detached are highly rounded.
- **<u>Step</u>:** Step fracture scars terminate abruptly in a right angle fracture.
- **<u>Edge Nibbling</u>:** An edge characterized as "nibbled" will exhibit micro-fractures which are too minute to categorize as scalar, hinge, step, or half-moon.

Experimental studies demonstrate that variations in microfractures are the result of several corresponding factors, including abrasion, adhesion, fatigue and chemical reactions (Donahue and Burroni 2004:141). The formation of fracture scars is also dependent upon the duration of use and the relative hardness of the material being worked.

Relative hardness of the worked material can generally be inferred from variations in the shape, distribution, and termination of microfractures. Analysts typically classify materials worked by dividing them into four broad categories based on relative hardness (Kooyman 2000; Odell and Odell Vereecken 1980; Vaughn 1981). The categories include "hard", "medium", "soft-medium", and "soft" (Table 5.2). When working hard materials, like dry antler, bone, and dry wood, flakes are detached at a much faster rate (Tringham et al. 1974). This rapid detachment tends to create larger, deeper, fracture scars with short, steep step terminations. Soaked hard woods and fresh bone are considered to be of medium hardness and are often identified with scarring that is medium to large in size. Flake terminations are predominantly hinged, but step fractures may also occur (Odell and Odell-Vereecken 1980). Materials considered to be soft-medium include soft woods, dry hides, and fibrous plants like reeds and some grasses. Scarring can be medium to large, but terminations tend to be feathered or poorly defined (Odell and Odell Vereecken 1980). Finally, soft materials include animal products (e.g. meat, skin, and fat) and non-fibrous plants. Flake scars, if present, tend to be smaller with feather terminations that may appear to be more irregular in both their shape and distribution along tool edge.

The overall morphology and distribution of microfractures along the ventral and dorsal surface of the active edge, also reveals important information regarding use action, or tool motion. In general, use actions include transverse and longitudinal motions, but can also include

Table 5.2: Hardness of Materials Worked Categories with Corresponding Flake Scar Characteristics

Hardness Category	**Probable Materials Worked**	**Microfracture Characteristics**
Hard	Bone, dry antler, dry hard wood	Large flake scars; step and hinge terminations
Medium	Fresh/soaked hardwood, fresh/ soaked antler, fresh bone	Medium to large flake scars, hinge and step terminations
Soft-Medium	Soft woods (oak), dry hides, fibrous plants (reeds, certain grasses)	Small to medium scars, feather terminations
Soft	Animal products (skin, meat, fat), fresh hide, non-fibrous plants	Small scalar scars, feather terminations

(Table adapted from Keeley 1980; Odell and Odell Vereecken 1980; Tringham et al. 1974*)*

chopping, boring, wedging, and abrading. Transverse motions include scraping, planing, and whittling, and typically results in the removal of dense, continuous flake scars on a single surface (Vaughn 1985:20). The macro and microfractures will generally be removed from the surface opposite the one which has direct contact with the worked material when the force and pressure applied is great enough (Tringham et al. 1974:187).

Longitudinal actions, like cutting and sawing, traditionally result in the removal of flake scars from both the ventral and dorsal surface. In general, the scars tend to be slanted and oriented diagonally to the working edge, but may be uneven and discontinuous, alternating from side to side, or favoring one side more than the other (Odell and Odell Vereecken 1980:98; Tringham et al. 1974:188-189). Odell and Odell-Vereecken (1980) note that true "one-way" cutting results in a directionality in the fracture scars that provide clues as to how the tool was held and which direction it was moved (1980:98). Sawing, a longitudinal-type motion, does not result in uni-directionality of scarring, but the other characteristics are similar (Odell and Odell-

Vereecken 1980:98).

Usewear associated with chopping is bifacial in nature, and tends to be symmetrical in appearance. Heavy impact, however, can result in asymmetrical wear patterns with well-defined hinge and step terminations (Odell and Odell-Vereecken 1980:99). Wedging and boring (e.g. drilling, perforating) produce wear patterns on the active edge similar to a chopping action. The primary difference observed, however, is that when the artifact is used as a wedge, there is additional edge damage on the opposite surface that was struck. The damage, depending upon the extent of use, hammer type, and material being worked, will consist of edge crushing or blunting.

It should be cautioned that the characteristics associated with microfractures, including morphology and distribution, should be viewed as averages or *tendencies*, rather than discrete, mutually exclusive characteristics (Odell and Odell-Vereecken 1980:98). In fact, some analysts argue that the results of usewear should be regarded as interpretations rather than concrete determinations (Lammers-Keijsers 2007). Various experimental programs have, for example, demonstrated varying degrees of edge wear damage, and instances where damage deviates from the aforementioned patterns. Vaughn noted substantial variability in microfracture patterns on tools used as part of his experimental program, even recording instances where fracture scars were not produced during use (1980:22-23). He attributes variation in patterns to differences in degree of edge angle, edge thickness, as well as the hardness of materials worked, and coarseness of raw material. Coarse-grained stone, like quartzite for example, is much more resistant to fracturing (Kooyman 2000).

5.3.3 Other Forms of Edge Damage

Edge damage that results from non-cultural processes also account for variability observed in microfractures and other categories of use-wear. Different post-depositional activities (i.e., trampling, excavation, curation, etc.) have been shown to produce not only microfractures, but can result in the formation of both striations and polish. The primary criteria used for distinguishing non-use damage is based on the regularity of the fracture scars, their orientation on the edge of the artifact, and their concentration on a particular portion of the tool's perimeter (Tringham et al. 1974:192). Experiments have shown that microfractures that form as the result of post-depositional processes are expected to be randomly distributed along a tool's edge. They tend to be spaced irregularly on all edges of an artifact, lack the concentration and patterning associated with cultural usewear, and have no fixed orientation or size (Odell and Odell-Vereecken 1980:96; Vaughn 1980).

Further complicating the characterization of microfractures are flake scars produced though secondary modification, or deliberate retouch, as well as prehension and hafting. Flakes detached can often be distinguished from use-related fractures on the basis of size of size, patterning, and distribution along a tool's edge. Edgewear recorded on experimental tools demonstrate that scars produced during use have certain mechanical limits; they tend to not only be smaller than retouched flakes, averaging between 2-3 mm (Kooyman 2000:153-154), but are also less patterned, and less invasive along a tool's edge (Tringham et al. 1974:181). Fracture scars produced as the result of deliberate modification have a tendency to be larger and more regular in shape and size, they also have shaper edges, and tend to be more invasive, encroaching further onto the surface of a tool (Odell and Odell-Vereecken 1980:97; Tringham et al. 1974:181).

Experimental observations have also distinguished wear patterns associated with prehension (grasping with the bare hand) and different forms of hafting. When tools are held, and there is considerable pressure and force exerted during use, flakes may be removed from the surface opposite the applied force (Odell and Odell-Vereecken 1980:103). In general, fractures are located on the surface or edge opposite the one on which pressure is exerted by the fingers. They consist of very small feather and step-terminating scalar scars that may not be visible macroscopically. Rots (2003) observed that prehensile scars tend to occur in distinct, clusters or patches along the edge. Polish also forms along the areas in contact with fingers or the palm, depending on how the tool was held (Rots 2003:18). A factor that contributes significantly to the form of the resulting flake scars and polish include the angle of applied force and position of the hand during use (Rots 2005). Experiments have demonstrated that a more oblique angle, or perpendicular force, will produce scale and feather-terminated flakes, whereas force applied from an acute angle results in a higher frequency of hinge and step terminations (Odell and Odell-Vereecken 1980:103). In comparison to use-related wear, and deliberate retouch, damage from prehension appears to be more irregularly patterned and unequally distributed on the lateral margins of a tool (Rots 2005:65).

Rots (2005) has demonstrated that damage associated with hafting can be distinguished from prehensile and use-related wear based primarily on the location along a tool's edge. Flake scars that result from hafting, for example, are more likely to be equally distributed along both lateral edges of the tool that were contained within the haft. The extent and characteristics of wear damage associated with hafts depend greatly on the contact material. The variability inherent in hide, wood, bone, and antler hafts will each result in the formation of distinctive polishes and microfractures. Experiments have shown that one can identify hafted areas on tools if areas exist in which the wear abruptly ends; this can be associated with the haft boundary (Rots 2005:68). This important trait can be used to distinguish between hand-held prehensile and hafting wear, as wear associated with hand-held tools often have no limit or boundary if the user continuously adjusted their grip or utilized multiple tool edges to complete a single task (Rots 2003:26). Because of the inherent variability observed in microfractures, many analysts have argued that they alone are not reliable indicators of tool function (Grace 1996; Shea 1992; Vaughn 1985). It is generally agreed upon that the combination of several additional attributes, or wear patterns, should lead to better results and more accurate interpretations of tool function.

5.3.4 Low-power Data Collection

When examining flake tools under low-power magnification, a number of attributes can be used as evidence of deliberate edge modification. These same attributes also provide information regarding tool use in terms of use action and hardness of materials worked. For this step in my analysis I examined each purported flake tool and recorded attributes on edges which appeared to have been modified through use or intentional retouch. The edge of a utilized flake is often referred to as the "working edge" and there are often multiple locations on a single flake which exhibit some form modification. In order to record data on each specimen, a photograph was taken of the dorsal and ventral surface of each flake and scale images were printed for data recording. Images were used to mark specific areas of edge damage which was useful for specimens which later underwent high-power analysis. I opted during this portion of the analysis to examine all probable flake tools, regardless of provience information. In doing so I was able to look at the entire sample, rather than a preselected portion which may not have been representative of the entire flake tool assemblage. All of the raw data, including data collection forms, have been curated electronically at the University of Tennessee's McClung Museum with the Mussel Beach artifacts and data collected by New South Associates.

Working Edge Characteristics:

As previously noted, the magnification capabilities of low-power microscope only permit the quantification of microfractures or flake scars, and thus all of the attributes recorded relate specifically to the types of microfractures present, their distribution along the working edges of flake tools, and the general morphology of the worked edge.

- **Location of Edge Damage:** During the analysis of each flake tool the location of edge damage was recorded as being present on any combination of the proximal and distal end, or left and right lateral margins. The location of damage or wear, in combination with other wear attributes, is used to determine which portion of the flake was utilized, or in contact with a worked material, and which portion was hafted or held in the hand during use (Andrefsky 2005:168). In addition to recording the location of edge damage the number of worked edges was also recorded for each specimen.
- **Patterning or Continuity of Working Edge:** Experiments with stone tools have found that flake scars produced as the result of use tend to be clustered together and appear uniform in shape, size, and type. Edge damage that was classified as patterned consisted of 4 or more uniform flake scars located within one centimeter of each other on the edge of the flake tool. Nonpatterned edge damage was characterized by isolated flake scars that occured at irregularly spaced intervals along the tool edge (Hayden 1979: 309). When the flake scars or clusters displayed varying facial orientation, flake scar type, and appeared randomly distributed, they were not classified as patterned and were thus not considered to

be of cultural origin.

- **Fracture Scar Length:** In order to determine if edge modification was the result of use or intentional retouching, flake scars were measured to the nearest 0.01mm using sliding digital calipers. Experiments with lithic artifacts have demonstrated that flake scars that result from use rarely exceed 2mm in length, while flake scars produced as the result of intentional retouching may exceed 3mm (Kooyman 2000:154). If flake scar length measured 2mm or less the edge damage was classified as unintentional modification produced during use. If flake scars measured greater than 2mm then the edge damage was classified as intentional retouch. The length of the modified edge is an important attribute to measure, as it may also reflect degree of retouch or tool utilization.
- **Edge Length:** Edge length refers to the total length of the modified portion of the tool edge. This measurement was obtained by taking the maximum linear distance along the worked edge of the tool. Because the edges of many flake tools are curved and irregular, it was necessary to stretch a string along the worked edge following the contours (Andrefsky 2005:173). By measuring the string it is possible to record the maximum edge length on even the most irregular tool edge. Edges with isolated fracture scars or clusters that did exceed more than 4mm in length were eliminated from the sample, and were classified as non-cultural. Experiments have demonstrated that isolated scars and small scars clusters can form during lithic reduction when the flake is detached, and also are common on flakes trampled or those swept up to be relocated to trash middens (McBreaty et al. 1998; McPherron et al. 2014; Tringham et al. 1979)

- **<u>Working Edge Morphology</u>:** Whether unintentionally or as the result of intentional retouching, the edge of a flake blank may change shape over the course of the tool's use-life. In order to understand flake blank selection it was important to characterize the working edge of flake tools based on the overall shape or morphology.
    - **<u>Edge Shape</u>:** Working edges of flake tools were visually assessed and characterized by their general morphology. Modified edges were record as: straight, concave, convex, or pointed. On those specimens with multiple worked margins, the shape of each was recorded.
    - **<u>Edge Angle</u>:** The angle of the working edge, while often difficult to measure, is an important characteristic of a tool's morphology. Edge angle has, for example, been used as a functional indicator by lithic analysts for defining specific use categories for tools (Crabtree 1973; Eren and Lycett 2016; Key and Lycett 2015; Siegal 1984). It has been suggested that tools whose edge angles fall into the lower ranges (i.e., 26 ° to 35 °) were likely used in a longitudinal motion, while tools with edge angles in the higher ranges (i.e., 50° to 65°) were used in a transverse motion (Hayden 1979; Siegal 1984; Wilmsen 1970). While this relationship has been demonstrated experimentally and archaeologically, functional interpretations should not be made without additional analyses of a tool's edge. Edge angle would have, however, influenced flake blank selection based on the needs of individual tool users. Edge angle measurements for flake tools for this analysis were estimated and not measured to the exact

degree. Using a contact goniometer as a guide, 8 angles (e.g. 10°, 20°, 30°, 40°, 50°, 60°, 70°, 80°) were cut into a 12 inch plastic ruler. The angled cuts extended only 3mm from the ruler edge. This distance was selected because it provided enough space for flakes of varying thicknesses, and in most instances flake scars did not exceed 3mm in length. Flake edges were inserted into the angled slots and best fit was recorded. Because flake tools may exhibit multiple used edges, edge angle was recorded for each worked edge.

The analysis of all flakes with evidence of damage under low-power magnification was necessary to accurately identify flake tools, eliminate flakes from the sample, and the further characterize flake tools based on specific microwear characteristics. The low-power analysis was also used as a guide in determining not only which artifacts would be selected for high-power functional analysis, but it also allowed me to make preliminary functional interpretations. Tools were *tentatively* identified as having been used in a transverse or longitudinal motion, and the materials worked were classified as soft, soft/medium, medium, medium/hard, and hard. No further functional interpretations could be made on the flake tools based on the low-power results. By examining flake tools under high-power magnification, functional interpretations can be hypothesized and further insight into tool function and use context can be achieved.

5.4 Assemblage Stratification and Flake Tool Typology

Based primarily on the degree of edge wear, continuity in flake scar patterning, and location of the flake scars along the edge of the working edge (i.e., lateral margins or distal end), the sample of flake blanks tentatively identified as tools was reduced from 924 to 489 specimens. The eliminated specimens were determined to be unused flaking debris and were thus returned to the non-tool debitage assemblage. Damage present on the eliminated specimens was classified as non-cultural, perhaps the result of post-depositional process, manufacturing activities, or a combination of both. At this point in the analysis, the remaining flake tool specimens were grouped together according to the temporal component in which they were associated. Unfortunately many of the flake tools identified at the Mussel Beach site were derived from mixed stratigraphic contexts that lacked provenience information. As such, only specimens derived from deposits with intact stratigraphy were selected for additional analysis and classification, which meant any specimen lacking a discrete context was further eliminated from the sample. In total 175 flake tool specimens were eliminated based on a lack of provenience, bringing the sample size for further analysis down to a total of 314 flakes distributed between each temporal occupation (Table 5.3). All of the specimens included in this sample exhibited areas with moderate to extensive edge damage characterized by patterned flake scars interpreted to have been produced during use or through intentional retouching. While this sample was reduced significantly during each step in the analysis, there is little doubt that the remaining specimens were the result of human modification, rather than spontaneous retouch. Unfortunately the number of specimens associated with the Late Woodland sample was too small to be statistically significant, and were therefore eliminated from the sample. In the event that this sample is analyzed in the future, it is noted here that it contained four use-modified and two retouched flake tools.

5.4.1 Flake Tool Typology

Having been reduced by more than half, the remaining flake tools were placed into typological categories. The categories reflect the degree of flake blank preparation, tool design, and the degree of investment in the tool. By deliberately modifying a flake to produce a

Table 5.3: Summary of Flake Tool Counts and Temporal Occupation after Low-power Analysis

Temporal Component	**Flake Tool Count**
Late Archaic I	28
Late Archaic II	51
Late Archaic III	119
Middle Woodland	110
Late Woodland	6
Total	**314**

particular edge or shape, toolmakers essentially changed the functional properties of that tool, therefore affecting the tool's use-life. The majority of flake implements at Mussel Beach appear to have been utilized with little to no retouch, and many were likely discarded before reaching the point of exhaustion. With the amount of morphological diversity present in the flake tool assemblage, the classification scheme devised categorized flake tools based on the degree of edge damage, and in some cases working edge morphology. The categories are not intended to be functional, but rather provide an effective strategy for stratifying tools based on intensity of edge damage or usewear.

Three categories of flake tools characterize the Mussel Beach assemblage; these include flakes classified simply as use-modified (n=262), those classified as retouched (n=39), and an additional class of flake tools which resemble formal retouched artifacts (n=7). Both modified and retouched tools are recognizable flakes, meaning they each retain a ventral and dorsal surface, intact to partially intact lateral and distal margins, and an identifiable point of percussion (Andrefsky 2005). The primary difference between retouched and modified flakes is the nature and extent of edge modification. Use-modified flakes (Figure 5.3) are those whose margins exhibit patterned flake scars that were produced unintentionally during use. Retouched flakes (Figure 5.4) show evidence of having been intentionally flaked, trimmed, notched or blunted to

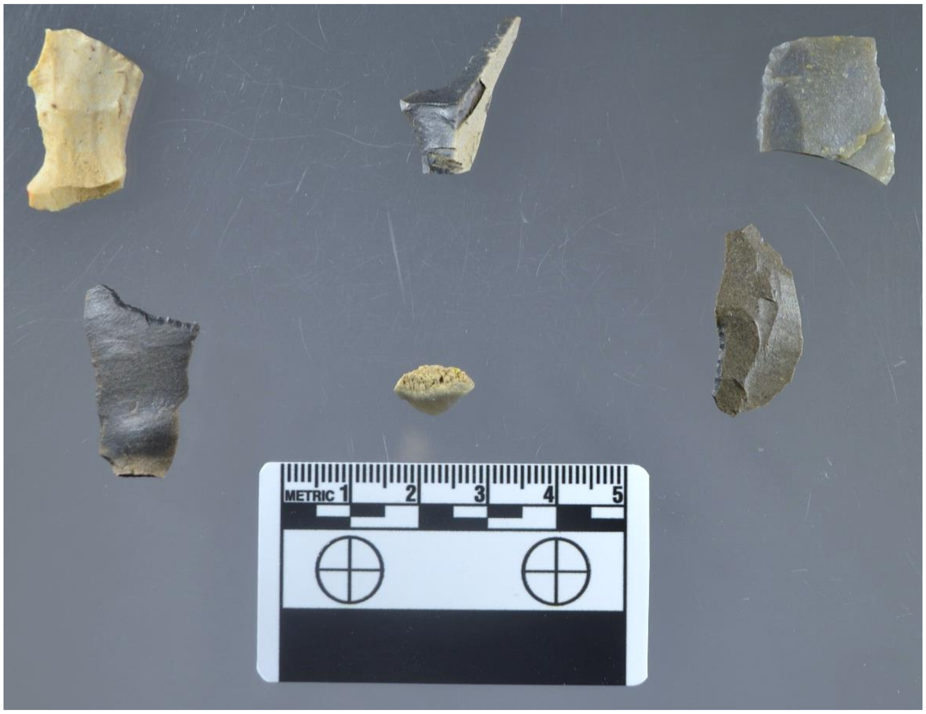


Figure 5.3: Sample of Use-Modified Flake Tools from the Mussel Beach Site (40MI70).

Figure 5.4: Sample of Retouched Flake Tools from Mussel Beach (40MI70)

produce one, or more, task-specific edges. The term retouch naturally implies intentional and purposeful modification of an artifact, from initial shaping through the maintenance, and recycling of one tool form into another (Odell 2004). The retouched edge, however, may not have been the functional edge, but rather the edge intended for prehension or hafting. Distinguishing between use-modified and retouched flakes can typically be achieved by measuring flake scar length and invasiveness away from the edge, and may also be distinguished by examining tools with low power magnification.

The formal retouched flake tools (Figure 5.5), by contrast, exhibit extensive modification which can cover a significant portion of the artifact, often extending beyond flake margins into the middle of the piece. As a consequence of the extensive retouching, formal flake tools no longer possess many of the distinguishing characteristics of flakes. To be characterized as a formal flake tool, however, specimens must exhibit an interior surface and should also contain an intact or partially intact striking platform. While modification tends to be restricted to only a single facial surface of the flake, some of these invasively retouched flake tools may exhibit a degree of bifacial retouch. The general shape or morphology of this latter category of flake tools often makes it easier to perceive the intended function of the tool. Many of the formal flake tools, for example, have been retouched to such an extent that they are identified as drills, perforators, and scrapers. All three flake tool categories are represented in within each temporal component at Mussel Beach (Table 5.4), although their distribution within each component differs considerably. Each of the tool types were recovered from several cultural features, including refuse middens, hearths, storage pits, and shell-processing middens. In the next section I provide additional information about each flake tool type and examine differences in flake tool assemblages by cultural component.

Figure 5.5: Sample of Formal Retouched Tools from Mussel Beach (40MI70)

Table 5.4: Summary of Expedient Lithic Artifacts

Expedient Flake Tools	**LA I**	**LA II**	**LA III**	**MW**	**Totals**
Use-Modified Flake	25	44	103	90	262
Retouched Flake	3	6	12	18	39
Formal Flake Tool	0	1	4	2	7
Totals	**28**	**51**	**119**	**110**	**308**

Use-modified Flakes:

As a class of artifacts, use-modified or utilized flakes are those which were used without having intentionally changed the shape or morphology of the flake blank. The edge damage or wear on these specimens resulted from use and not intentional modification. These tools exhibit considerable morphological diversity and are considered to be unstandardized with regard to form or style. Non-retouched modified flakes generally fall within the category of expedient technology and are intended for immediate use. Unlike formal tools, the production of flake blanks for utilization required the expenditure of very little energy. Flake tools selected for use would have contained functional edges appropriate for the task at hand. The lack of retouch on such specimens suggests that they were discarded soon after the task was completed and were not intended to be rejuvenated or redesigned for future use. Expedient flakes have the potential to be used for multiple tasks before being discarded. A single implement can, for example, be used to cut, scrape, or saw a variety of materials if the edge angles are suitable for such tasks. The shape of the working edge, in combination with the location, distribution, and morphology of the flake scars can reveal significant information regarding tool function. Flake characteristics, including linear dimensions, edge angle, dorsal cortex, and raw material may also reveal a preference for flakes with specific functional attributes.

The assemblage of use-modified flake tools from Mussel Beach that were recovered from contexts with intact stratigraphy include a total of 262 specimens. The sample consisted of complete flakes (n=168; 64%), broken flakes (n=38; 15%), flake fragments (n=49; 19%), and shatter (n=7; 2%). In most cases, the broken flakes and flake fragments appear to have been selected for use after the specimen became fragmented. Only a small sample of tools show evidence of having been broken during use or after discard. While there was, overall, a preference for flake blanks with intact lateral and/or distal margins, the results of the Chi-Square indicate that slightly more flake fragments were utilized as tools than expected. In order to determine if the selection of flake blanks by condition differed between each temporal component, a Chi-Square test of independence was performed (Table 5.5 and 5.6). At a p-value of .503, it is evident that there was no significant difference between flake selection in terms of condition between each of the cultural occupations. Tool users continued to prefer complete flake blanks for tool selection over broken or fragmented pieces (Figure 5.6).

The combined assemblage of use-modified flakes produced a mean length of 23.96 mm, a mean width of 16.43 mm, and a mean thickness of 4.13 mm (Table 5.7 and Table 5.8). Overall these are not large specimens, and the size of the blanks being selected for use is likely related to the size of the core. While the use-modified flakes are relatively small, they contain a mean edge angle of 54.96° (Table 5.9). Functionally, edge angles ranging between 50-60° are more suitable for tasks requiring a transverse-type motion as opposed to cutting or sawing, but they can also function quite well as cutting implements.

When comparing mean edge angle between each of the temporal components (Table 5.10), a Chi-Square test of independence results in a p-value of 0.00, indicating that there is a significant difference between flake selection based on edge angle between each of the temporal components (Table 5.11 and 5.12). To understand where these differences occur, it was necessary to look closer at the Chi-Square data. After doing so, it became apparent that during the Late Archaic III occupation, tool users selected fewer flakes than expected with a 50° edge angle and more than expected flakes with a 60° angle. Also, during the Middle Woodland, tool users selected more flakes than expected with a 50° edge angle, and fewer flakes than expected with a 60° edge angle. In order to fully understand the influence that edge angle had on tool

Table 5.5: Chi-Square Test of Independence between Flake Condition and Temporal Component for Use-Modified Flakes Showing Exact and Expected Counts

Temporal Component	**Complete**	**Broken**	**Fragment**	**Shatter**	**Totals**
LA I	19 (15.9)	4 (3.5)	2 (4.7)	0 (.7)	**25**
LA II	32 (28.0)	5 (6.2)	7 (8.2)	0 (1.2)	**44**
LA III	62 (65.7)	14 (14.5)	25 (19.3)	2 (2.8)	**103**
MW	55 (57.4)	15 (12.7)	15 (16.8)	5 (2.4)	**90**
Totals	**168**	**38**	**49**	**7**	**262**

(X^2=14.29,df=15, P=.503)

Table 5.6: Results of Chi-Square Test of Independence between Flake Condition and Temporal Component for Use-modified Flakes

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	14.294[a]	15	.503
Likelihood Ratio	16.191	15	.369
N of Valid Cases	262		
a. 14 cells (58.3%) have expected count less than 5. The minimum expected count is .10.			

Table 5.7: Summary of Mean Length, Width and Thickness (mm) for Use- Modified Flakes

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Length	262	.41	55.79	23.9607	8.06016
Width	262	3.82	40.21	16.4345	5.57718
Thickness	262	.74	16.77	4.1367	2.37164
Valid N (listwise)	262				

Table 5.8: Comparison of Mean Length, Width, and Thickness (mm) for Use-modified Flakes at Mussel Beach

Temporal Component	**Length (mm)**	**Width (mm)**	**Thickness (mm)**
LA I	26.24	16.84	4.09
LA II	24.30	17.36	3.74
LA III	24.26	15.99	3.82
MW	22.94	16.64	3.77

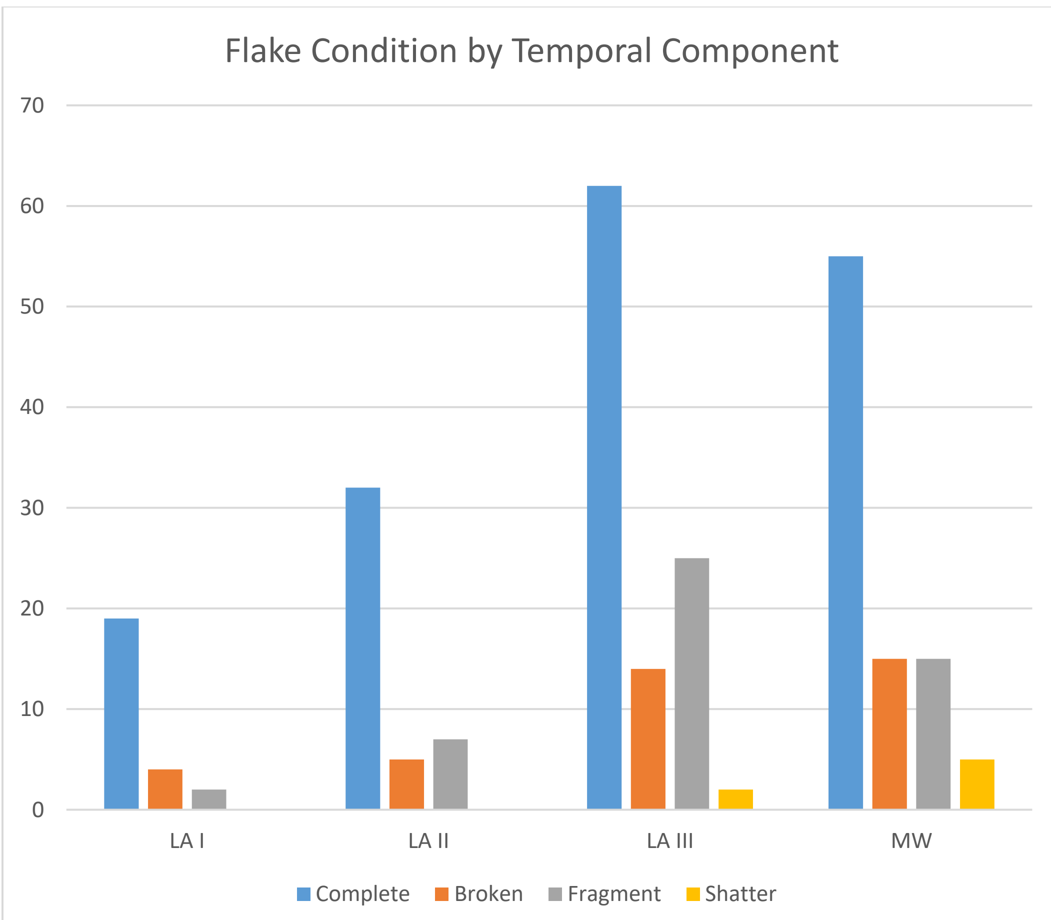


Figure 5.6: Distribution of Use-Modified Flake Tools by Condition for Each Temporal Component

Table 5.9: Mean Edge Angle for Modified Flake Specimens

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Edge Angle	262	10	80	54.96	15.357
Valid N (listwise)	262				

Table 5.10: Comparison of Mean Edge Angle for Modified Flakes between Temporal Components

Descriptive Statistics			
Dependent Variable: Angle ○			
Component	Mean	Std. Deviation	N
LA I	50.80	17.718	25
LA II	54.44	16.591	44
LA III	56.76	14.643	103
MW	52.34	16.449	90
Total	54.29	15.973	262

Table 5.11: Chi-Square Test of Independence for Edge Angle for Use-modified Flakes between Temporal Components

Component	**>20°**	**20°**	**30°**	**40°**	**50°**	**60°**	**70°**	**80°**	**Totals**
LA I	2 (.2)	2 (1.5)	1 (1.7)	1 (1.1)	5 (5.9)	7 (7.7)	7 (5.7)	0 (1.0)	25
LA II	0 (.3)	4 (2.7)	2 (3.0)	1 (2.0)	11 (10.4)	14 (13.6)	10 (10.1)	2 (1.8)	44
LA III	0 (.8)	5 (6.3)	7 (7.1)	6 (4.7)	13 (24.4)	47 (31.8)	23 (23.6)	2 (4.3)	103
MW	0 (.7)	5 (5.5)	8 (6.2)	4 (4.1)	33 (21.3)	13 (27.8)	20 (20.6)	7 (3.8)	90
Totals	**2**	**16**	**18**	**12**	**62**	**81**	**60**	**11**	**262**

(X^2=54.60, df=21, *P*=.000)

Table 5.12: Results of Chi-Square test for Independence for Edge Angle on Use-Modified Flakes between Each Temporal Component

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	54.601[a]	21	.000
Likelihood Ratio	47.105	21	.001
N of Valid Cases	262		
a. 16 cells (50.0%) have expected count less than 5. The minimum expected count is .19.			

selection, it is necessary to explore the relationships between edge angle and tool function. A flake with a 60° is more suitable for scraping tasks, while a 50° could probably functional well for both cutting and scraping activities depending upon the hardness of the raw materials being processed. This relationship will be assessed in Chapter 6 following the results of the high-power analysis.

With regards to the morphology of the working edges for the use-modified flake tools, the most frequently occurring edge shape was straight (n=165; 63%), this was followed by convex (n=41; 16%), concave (n=31; 12%), and pointed (25; 10%). On many specimens it is apparent that the shape of the working edge was produced as the result of use, and perhaps would not have been characterized as straight or concave prior to utilization. Flakes with straight edges are the most frequently used flake types between all temporal components (Figure 5.7), and this is not surprising because a straight edge can be used in both a scraping and cutting motion. A Chi-Square test was used to compare the edge shape of use-modified flakes between each temporal occupation (Table 5.13). The results indicate that there were no significant changes in the shape of use-modified flake edges throughout the site's occupation (Table 5.14). This is not surprising given that many expedient tools are generic, and often times opportunistic in nature.

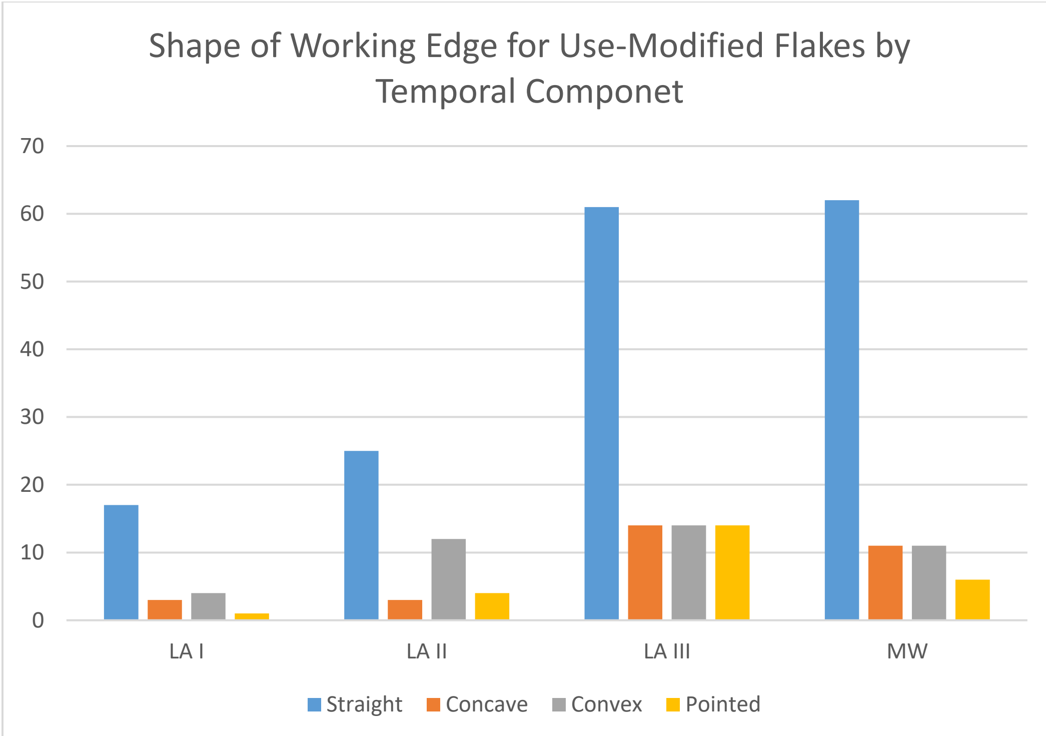


Figure 5.7: Summary of Modified Flake Tool Edge Shape by Temporal Component

Table 5.13: Chi-Square Test of Independence for Use-modified Flakes for Edge Shape between Temporal Component

Component	**Straight**	**Concave**	**Convex**	**Pointed**	**Totals**
LA I	17 (15.7)	3 (3.0)	4 (3.9)	1 (2.4)	25
LA II	25 (27.7)	3 (5.2)	12 (6.9)	4 (4.2)	44
LA III	61 (64.9)	14 (12.2)	14 (16.1)	14 (9.8)	103
MW	62 (56.7)	11 (10.6)	11 (14.1)	6 (8.6)	90
Totals	**165**	**31**	**41**	**25**	**262**

(X^2=10.43, df=9, P=.317)

Table 5.14: Results of a Chi-Square Test of Independence for Edge Shape for Use-Modified Flakes between Temporal Components

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	10.431[a]	9	.317
Likelihood Ratio	10.070	9	.345
N of Valid Cases	262		
a. 4 cells (25.0%) have expected count less than 5. The minimum expected count is 2.39.			

Unmodified flakes tend to be used for a variety of tasks, none of which required specialized tools or edges to complete, and moreover they are used without the need for additional modification (Figure 5.8).

The use-modified flake tools at Mussel Beach were produced from a wide variety of raw materials which, for the most part, are considered to be locally available resources. The most frequently utilized type of chert was Bangor (n=98; 37%), and this was followed by Monteagle (n=50; 19%), variants of Fort Payne (n=50; 19%), Knox (n=30; 11%), St. Louis (n=16; 6%), and a small sample of modified specimens were manufactured from chalcedony (n=4; 2%). A totalof fourteen flake tools were manufactured from chert types that I was unable to identify, 6 (2%) because they were thermally altered, and 8 specimens were produced from a fine-grained amber colored chert that I could not identify using the available reference samples. Looking at the overall distribution of chert types, it was not surprising to find that the majority of the flake tools were produced from locally available raw materials given the quality of the chert and its relative abundance in the area. Between each temporal component are observable changes in the use of raw materials (Figure 5.9) for flake tools. While Bangor is utilized consistently during each phase of occupation, the preference for other raw material types fluctuates. In order to determine if the fluctuations are statistically significant, a Chi-Square test of independence was utilized

Figure 5.8: Sample of Use-modified Flake Tools with Straight, Concave, Convex, and Pointed Edges.

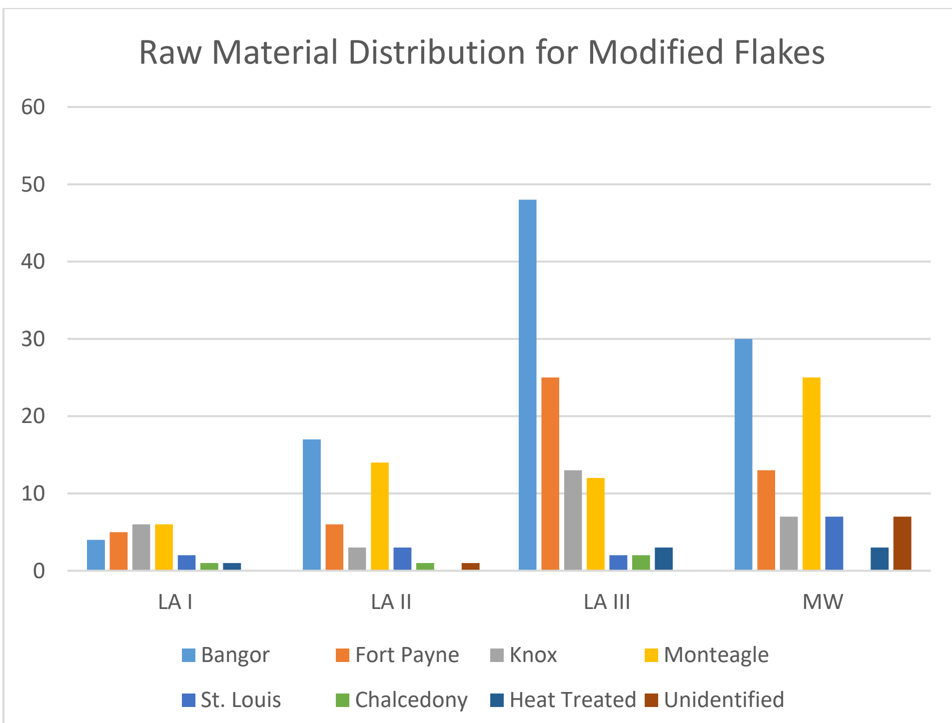


Figure 5.9: Distribution of Raw Material Types for Modified Flakes between Each Temporal Component

testing the variable raw material between temporal components (Table 5.15). The results indicate that there are enough differences in raw selection between occupations to be statistically significant (Table 5.16).

Differences in the utilization of raw material types may be related to the intensity of lithic reduction activities occurring during each phase of occupation as well as the purpose of lithic reduction during each component. Different raw material types may be selected for use in the production of different tool types, and this can be related to the material properties of the tool stone. Raw material coarseness and nodule/core size are two factors which likely influenced production activities. Additional factors affecting raw materials selection could also be related to the intensity of occupation, as well as changes in the availability of local chert. A preference for specific raw materials for flake blanks may also be related to tool function, as the physical and mechanical properties of cherts can affect tool durability and use-life. This will be explored further in Chapter 6.

When considering reduction stages associated with the modified flake tools it was necessary to take into account the following attributes: percentage of dorsal cortex and dorsal flake scar count. As previously noted, the percentage of dorsal cortex was recorded using an ordinal scale, wherein flakes were given a value of 0-3 based on the estimated cortex percentage. The percentage of dorsal cortex was also used to characterize flakes in terms of their stage in the reduction sequence. Flakes whose percentage of dorsal cortex was estimated to be between 100 and >50% were classified as “Primary Decortification” flakes, those with less than 50% dorsal cortex were characterized as “Secondary Decortification” flakes, and those that lacked cortex were classified as “Tertiary” flakes. Flakes within each of the aforementioned categories tend to correlate with early, middle, and late stage reduction. The modified flake assemblage contained

Table 5.15: Chi-Square Test of Independence for Use-modified Flakes for Raw Material between Temporal Component

Component	Fort Payne	Knox	Bangor	St. Louis	Monteagle	Heated	Chalcedony	Unidentified	Total
LA I	5 (4.8)	6 (2.9)	4 (9.4)	2 (1.5)	6 (4.8)	(.6)	1 (.4)	0 (.8)	25
LA II	6 (8.4)	3 (5.0)	17 (16.5)	3 (2.7)	13 (8.4)	0 (1.0)	1 (.7)	1 (1.3)	44
LA III	28 (19.7)	12 (11.8)	45 (38.5)	2 (6.3)	12 (19.7)	2 (2.4)	2 (1.6)	0 (3.1)	103
MW	11 (17.2)	9 (10.3)	32 (33.7)	9 (5.5)	19 (19)	3 (2.1)	0 (1.4)	7 (2.7)	90
Total	**50**	**30**	**98**	**16**	**50**	**6**	**4**	**8**	**262**

(X^2=41.53, df=21, *P*=.005)

Table 5.16: Results of a Chi-Square Test of Independence on Use-modified flakes for Raw Materials between Temporal Components

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	41.534[a]	21	.005
Likelihood Ratio	46.267	21	.001
N of Valid Cases	262		
a. 17 cells (53.1%) have expected count less than 5. The minimum expected count is .38.			

a relatively small sample of primary flakes (n=42; 16%), a moderate amount of secondary flakes (n=75; 29 %), and a much greater sample of tertiary flakes (n=145; 55%). Overall, there are only minor differences in the raw materials utilized for the assemblages of use-modified flake tools between temporal components (Figure 5.10) based on cortical percentage. The frequencies of stage flakes, based on dorsal scar count, were also compared between each of components using a Chi-Square test of independence (Table 5.17 and 5.18). The results of the Chi-Square also indicate that there was no difference in flake selection based on reduction stages

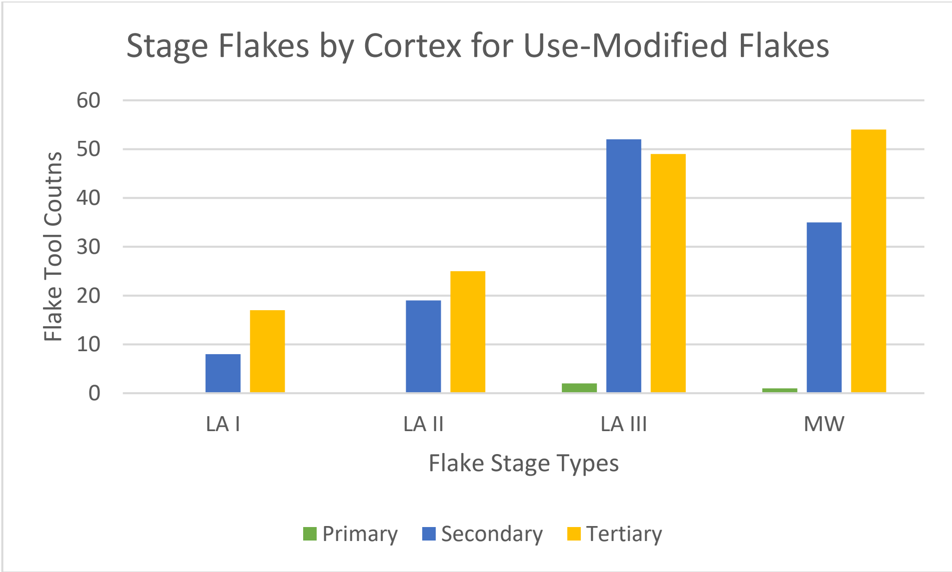


Figure 5.10: Summary of Stage Flakes for Use-Modified Assemblage between Temporal Component

Table 5.17: Chi-Square Test of Independence for Use-modified Flakes for Stage Flakes between Temporal Component

Component	Primary	Secondary	Tertiary	Totals
LA I	0 (.3)	8 (10.9)	17 (13.8)	25
LA II	0 (.5)	19 (19.1)	25 (24.4)	44
LA III	2 (1.2)	52 (44.8)	49 (57.0)	103
MW	1 (1.0)	35 (39.2)	54 (49.8)	90
Total	**3**	**114**	**145**	**262**

(X^2=6.63,df=9, P=.675)

Table 5.18: Results of the Chi-Square Test of Independence for Use-modified Flake for Stage Flakes between Temporal Components

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	6.631[a]	9	.675
Likelihood Ratio	7.372	9	.598
N of Valid Cases	262		
a. 5 cells (31.3%) have expected count less than 5. The minimum expected count is .29.			

between each occupation at the Mussel Beach site.

As previously mentioned, dorsal scar count was recorded using an ordinal scale, wherein the designation of "0" meant that there were either no dorsal scars or the surface was completely covered in cortex, flakes with a value of "1" contained 1-2 flake scars, the value of "2" represented 3-5 flake scars, and lastly the value of "3" represented flakes with 6 or more flake scars. While it has been shown that flakes with more dorsal fracture scars tend to be removed later in the reduction sequence, it has been demonstrated that flakes detached during the later stages of reduction and during tool maintenance may exhibit very little evidence of previous removals. As a result, dorsal scar count alone cannot accurately assess stages of reduction and should be considered in combination with other attributes. Within the modified tool assemblage, 60 (23%) flakes contained either 0 flake scars or 100% dorsal cortex, 72 (27%) contained only 1-2 flake scars, 108 (41%) contained 3-5 flakes scars, and only 22 (8%) flakes contained 6 or more negative flake scars on the dorsal surface. When a Chi-Square test of independence was used to compare flake scar counts between temporal components (Table 5.19) for use-modified flake tools, the result is significant at a p-value of .004 (Table 5.20).

When looking more closely at the results, it appears that some of the most significant discrepancies between the observed and expected outcomes occur during the Middle Woodland occupations. During the Middle Woodland, the frequency of flakes with no previous flake removals increases more than expected from the earlier cultural components. When looked at in combination with the frequency of decortification flakes, it is apparent that there are definite changes in reduction activities from the Late Archaic III to the Middle Woodland, with an increased emphasis on late stage reduction and possibly maintenance activities during the latter occupation. In general, however, flakes selected for use as tools were produced during all stages

Table 5.19: Chi-Square Test of Independence for Use-modified Flakes between Dorsal Flake Scar Count and Temporal Component

Component	**0 Flake Scars**	**1-2 Flake Scars**	**3-5 Flake Scars**	**6+ Flake Scars**	**Totals**
LA I	3 (5.7)	5 (6.9)	13 (10.3)	4 (2.1)	25
LA II	4 (10.1)	14 (12.1)	22 (18.1)	4 (3.7)	44
LA III	18 (23.6)	33 (28.3)	44 (42.5)	8 (8.6)	103
MW	35 (20.6)	20 (24.7)	29 (37.1)	6 (7.6)	90
Totals	**60**	**72**	**108**	**22**	**262**

(X^2=24.29, df=9, *P*=.004)

Table 5.20: Results of Chi-Square Test of Independence for Use-modified Flakes between Dorsal Flake Scar Count and Temporal Component

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	24.412[a]	9	.004
Likelihood Ratio	23.902	9	.004
N of Valid Cases	262		

a. 2 cells (12.5%) have expected count less than 5. The minimum expected count is 2.10.

of lithic reduction. There is a slight emphasis, however, on flakes detached during the middle stages of reduction. This might suggest a greater emphasis on core preparation and the desire to produce flakes of a particular size and/or shape.

During core reduction, the production of a particular type of flake depends on several factors, some of which include the size and quality of the raw material, type of technology utilized, knapper skill, and degree of platform preparation. Prepared platforms include those that are faceted and abraded, while unprepared platforms are cortical and flat. Modified flake tools that were missing platforms or contained crushed platforms are not reported here, as neither condition has been shown to be related directly to the intentional preparation of the point of percussion. From the remaining sample, the modified flake tools contained 132 (61%) unprepared platforms and 83 (39%) prepared platforms. Of the unprepared platforms, only a small percentage were cortical (n=43; 33%), while the remaining contained flat platforms (n=89; 67%). Of the specimens with prepared platforms, 32 (39%) were abraded while the remaining specimens contained faceted platforms (n=51; 61%). The proportions of unprepared to prepared platforms demonstrates that tool users were engaged in different types of reduction activities. There is evidence for primary reduction, which may not have necessitated considerable platform preparation, as well as middle to late stage reduction, wherein tool makers were attempting to control flake detachments by modifying striking platforms.

Retouched Flake Tools

Flake tools classified as being retouched exhibit evidence of intentional retouching in the form of secondary edge modification. The removal of flake scars from the distal or lateral flake margins demonstrates a desire to alter the shape of the tool's edge to either improve the tool's function or prepare the edge for hafting or prehension. The extent of retouching associated with this class of flake tools is limited to the immediate tool edge and does not extend more than 3mm on the flake's surface. Retouched flake tools in the context of the Mussel Beach site are informal, and the retouching is related to function and not style. By intentionally modifying the flake tool, the tool user demonstrates a degree of investment in the artifact, but the limited extent of modification associated with these implements suggests that they were not intended for long-term use or future curation. Similarly to modified flakes, retouched flake tools are considered to be expedient and opportunistic in nature. It is likely that these specimens were situational and were discarded on site after use, rather than being transported with tool users after the location was abandoned. The nature of the retouching, particularly any changes associated with the shape of a tool's edge, may provide information related to the tools intended function.

The sample of retouched flakes tools is appreciably smaller than the modified flake tools, consisting of only 39 specimens. The types of retouched flakes included complete flakes (n=18; 46%), broken flakes (n=2; 5%), flake fragments (n=10; 26%), and shatter (n=5; 13%). The remaining specimen (n=3; 8%) were retouched on the distal margin making it difficult to discern the flake's condition prior to modification. Compared to the use-modified specimens, flakes selected for retouching were more frequently fragmented or broken, and intact lateral and distal margins were not necessary for the tool to be functional. When compared statistically using a chi-square test of independence (Table 5.21), differences in flake tool selection by condition between the use-modified and retouched flake tools is statistically significant (Table 5.22).

While the total sample of retouched tools is small for each phase of occupation, a Chi-Square test of independence was performed testing the variable condition between temporal components (Table 5.23). The results of the Chi-Square indicated that there was not a significant difference (Table 5.24) between flake blank selection by condition between each of the cultural components (Figure 5.11). This might suggest that the flakes being selected for retouching were chosen based on morphological characteristics other than condition. It is likely that size, shape, and edge angle were more likely to influence tool selection that flake condition alone. However, it is also possible that the flakes were chosen for use randomly and if they failed fulfill some specific criteria they were later modified or retouched to suite some functional need.

The retouched flake tools are also modest in size with a mean length of 23.71 mm (Table 5.25), mean width of 17.72 mm, and a mean thickness of 4.07 mm (Table 5.26). In comparison to the use-modified flake tools, the retouched tools vary only slightly in mean length, width, and

Table 5.21: Chi-Square Test of Independence for Flake Condition between Use-modified and Retouched Flake Tools

Flake Tool-Type	Complete	Broken	Fragment	Shatter	Totals
Use-Modified	173 (169.7)	36 (33.6)	52 (54.8)	6 (8.8)	267
Retouched	19 (22.3)	2 (4.4)	10 (7.2)	4 (1.2)	35
Totals	**192**	**38**	**62**	**10**	**302**

(X^2=11.14, df =3, P=.011)

Table 5.22: Results of Chi-Square Test of Independence for Tool Condition between Use-modified and Retouched Flake Tools

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	52.083[a]	9	.000
Likelihood Ratio	36.673	9	.000
Linear-by-Linear Association	16.992	1	.000
N of Valid Cases	302		

a. 14 cells (70.0%) have expected count less than 5. The minimum expected count is .13.

Table 5.23: Chi-Square Test of Independence for Flake Condition between Retouched Flake Tools and Temporal Components

Component	Complete	Broken	Fragment	Shatter	Totals
LA I	2 (1.0)	0 (.2)	0 (.6)	0 (.3)	2
LA II	2 (2.5)	1 (.2)	1 (1.4)	1 (.7)	5
LA III	5 (5.5)	0 (.6)	6 (3.4)	1 (1.5)	12
MW	10 (9.0)	1 (.8)	3 (5.0)	2 (2.5)	16
Totals	**19**	**2**	**10**	**4**	**35**

(X^2=15.74, df=18, P=.611)

Table 5.24: Results of the Chi-Square Test of Independence for Flake Conditions between Retouched Flake Tools and Temporal Component

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	15.740[a]	18	.611
Likelihood Ratio	14.696	18	.683
N of Valid Cases	36		

a. 25 cells (89.3%) have expected count less than 5. The minimum expected count is .06.

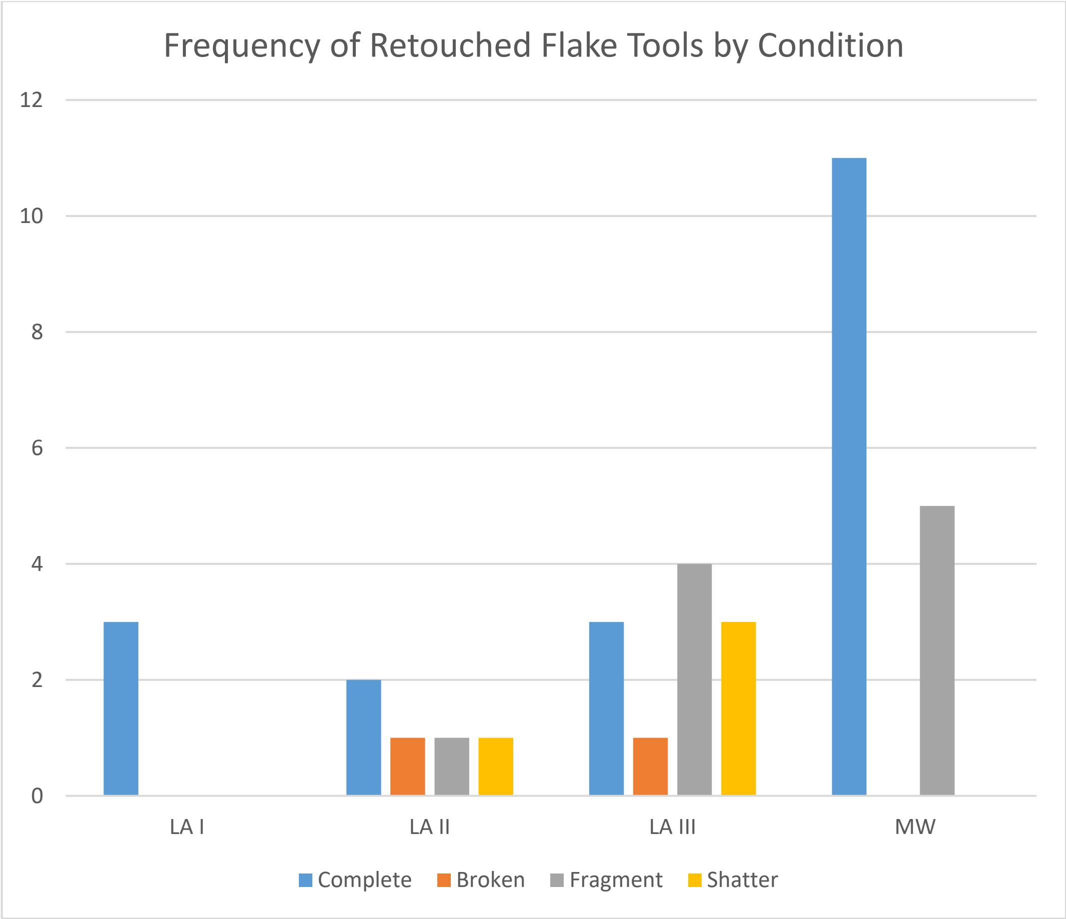


Figure 5.11: Summary of the Distribution of Retouched Flake Tools by Condition for each Temporal Component

Table 5.25: Mean Length for Retouched Flake Tools (mm)

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Length	39	8.01	46.77	25.6150	8.89770
Valid N (listwise)	39				

Table 5.26: Mean Width and Thickness for Retouched Flake Tools (mm)

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Width	39	5.77	35.97	17.7231	5.24279
Thickness	39	1.60	11.11	4.0736	2.09576
Valid N (listwise)	39				

thickness (Table 5.27). Similar tool dimensions suggests that size was not an important factor in flake blanks selected for retouching. Based on the mean thickness of the retouched flake tools it was not surprising that the mean edge angle was 67.18° (Table 5.28). This degree of edge angle suggests that the tools may have been utilized in transverse type actions, although longitdunal actions may also be possible. In order to determine if there were differences in mean edge angle between use-modified and retouched flake tools, a Chi-Squar test of independence was performed using the variable edge angle (Table 5.29). The results of the Chi-Square test indicated a statistically significant difference (Table 5.30).

When the results of the Chi-Square test for edge angle between flake tool types is examined, it becomes evident that retouched flake tools exhibit a greater frequency of flakes with edge angles measuring between 70° and 80° than was expected. As previously mentioned, the edge angle could indicate transverse tool motions, but these angles may also be associated with tool edges which have been retouched for prehension or hafting. Edge angles were

Table 5.27: Comparison of Mean Length, Width, and Thickness between Use-modified and Retouched Flake Tools (mm)

Flake Tool Type	**Length (mm)**	**Width (mm)**	**Thickness (mm)**
Use-modified	23.96	16.43	4.13
Retouched	23.71	17.72	4.07

Table 5.28: Mean Edge Angle for Retouched Flake Tools

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Edge Angle	39	20	80	67.18	13.945
Valid N (listwise)	39				

Table 5.29: Chi-Square Test of Independence for Edge Angle between Use-modified and Retouched Flake Tools

Edge Angle	**Use-modified**	**Retouched**	**Totals**
<20°	2 (1.7)	0 (.3)	2
20°	16 (15.7)	2 (2.3)	18
30°	18 (15.7)	0 (2.3)	18
40°	11 (9.6)	0 (1.4)	11
50°	63 (54.8)	2 (8.4)	65
60°	81 (78.3)	9 (11.7)	90
70°	60 (66.2)	16 (9.8)	76
80°	11 (18.3)	10 (2.7)	21
Totals	**262**	**39**	**301**

(X^2=41.07, df=7, *P*=.000)

Table 5.30: Results Chi-Square Test of Independence for Edge Angle between Use-Modified and Retouched Flakes

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	63.087[a]	7	.000
Likelihood Ratio	62.975	7	.000
Linear-by-Linear Association	38.399	1	.000
N of Valid Cases	301		
a. 6 cells (37.5%) have expected count less than 5. The minimum expected count is .26.			

recorded on all flake edges which exhibited evidence of use, and as previously noted it can be difficult to differiate between use-related retouching and retouching associated with hafting or prehension. A Chi-Square test of independence (Table 5.31 and 5.32) was also performed to look for differences between edge angle on retouched flake tools between temporal components. The results indicate that there are no significant differences in edge angle for the retouched tools between each of cultural occupations. The relationships between tool function and edge angle for the retouched tools will be evaluated further in Chapter 6.

The shape of the retouched flake tools include 13 (33%) straight edged tools, 8 (21%) with concave edges, 2 (5%) with a convex edge, and 16 (41%) with pointed edges. A Chi-Square test of independence was used to compare edge shape between the use-modified and retouched tools (Table 5.33). The results indicate that there is a significant difference in edge shape between the two tool groups (Table 5.34). Among the retouched tool assemblage, flakes with straight edges occur less frequently than expected, while tools with pointed edges occur more frequently. Such differences between the assemblages are to be expected, as straight edges are produced naturally during flake reduction and retouching is often required to achieve a

Table 5.31: Chi-Square Test of Independence for Edge Angle of Retouched Tools between Temporal Components

Edge Angle	LA I	LA II	LA III	MW	Totals
20°	0 (.2)	1 (.3)	0 (.6)	1 (.9)	2
50°	0 (.2)	0 (.3)	0 (.6)	2 (.9)	2
60°	1 (.7)	1 (1.4)	4 (2.8)	3 (4.2)	9
70°	2 (1.2)	2 (2.3)	4 (4.9)	8 (7.4)	16
80°	0 (.8)	2 (1.7)	4 (3.1)	4 (4.6)	10
Totals	**3**	**6**	**12**	**18**	**39**

(X^2=7.84, df=12, P=.798)

Table 5.32: Results of the Chi-Square Test of Independence for Edge Angle of Retouched Tools between Temporal Components

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	7.836[a]	12	.798
Likelihood Ratio	9.419	12	.667
N of Valid Cases	39		
a. 19 cells (95.0%) have expected count less than 5. The minimum expected count is .15.			

Table 5.33: Chi-Square Test if Independence for Edge Shape between Use-modified and Retouched Flake Tools

Tool Type	Straight	Concave	Convex	Pointed	Totals
Use-modified	165	31	41	41	262
Retouched	13	8	2	2	39
Totals	**178**	**39**	**43**	**43**	**301**

(X^2=34.35, df=3, P=.000)

Table 5.34: Results of the Chi-Square Test of Independence between Tool Type and Edge Shape

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	34.352[a]	3	.000
Likelihood Ratio	28.442	3	.000
Linear-by-Linear Association	18.268	1	.000
N of Valid Cases	301		
a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 5.05.			

pointed edge.

In general, the frequency of retouched tools with pointed edges increases from the Late Archaic II to the Late Archaic III and Middle Woodland occupations (Figure 5.12). However, when edge shape between temporal component is compared using a Chi-Square test of independence (Table 5.35), the results are not significant (Table 5.36). This might suggest that there were only slight changes in terms of tool use between each component. In terms of the morphology of these tools, the pointed implements recovered from the Late Archaic I and Late Archaic II only exhibit retouching on a single lateral margin, forming of a 90° edge. The majority of the pointed tools associated with the Late Archaic III and Middle Woodland occupations, in contrast, exhibit retouching on more than one margin, effectively creating a more refined pointed edge that resembles a perforator or drill (Figure 5.13). By retouching the edges to such a degree, many of these pointed tools are considered to be specialized implements that were used to complete a much narrower, or specialized, range of tasks.

The types of chert utilized for retouched flake tools include Bangor (n=10; 26%), varieties of Fort Payne (n=14; 36%), Knox Black (n=3; 8%), Monteagle (n=9; 23%), and St. Louis (n=3; 8%) (Figure 5.14). Tools with evidence of thermal alteration are noticeably rare

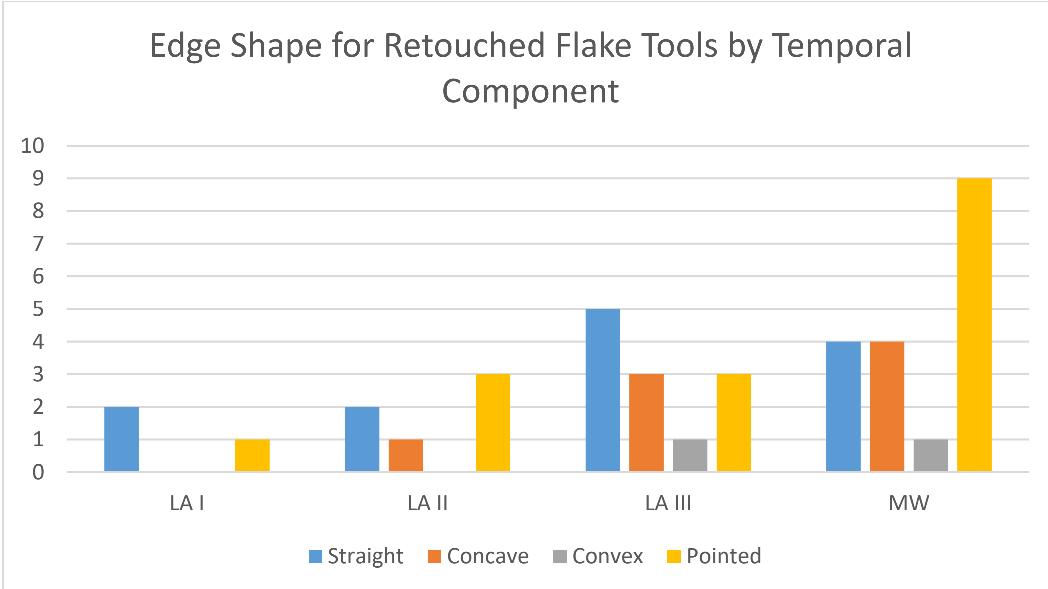


Figure 5.12: Summary of Edge Shape for Retouched Tools by Component

Table 5.35: Chi-Square Test of Independence for Edge Shape for Retouched Tools between Temporal Components

Component	Straight	Concave	Convex	Pointed	Totals
LA I	2 (1.0)	0 (.6)	0 (.2)	1 (1.2)	3
LA II	2 (2.0)	1 (1.2)	0 (.3)	3 (2.5)	6
LA III	5 (4.0)	3 (2.5)	1 (.6)	3 (4.9)	12
MW	4 (6.0)	4 (3.7)	1 (.9)	9 (7.4)	18
Totals	**13**	**8**	**2**	**16**	**39**

(X^2=4.69, df=9, *P*=.860)

Table 5.36: Results of Chi-Square Test of Independence between Edge Shape for Retouched Flake Tools

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	4.693[a]	9	.860
Likelihood Ratio	5.664	9	.773
N of Valid Cases	39		

a. 14 cells (87.5%) have expected count less than 5. The minimum expected count is .15.

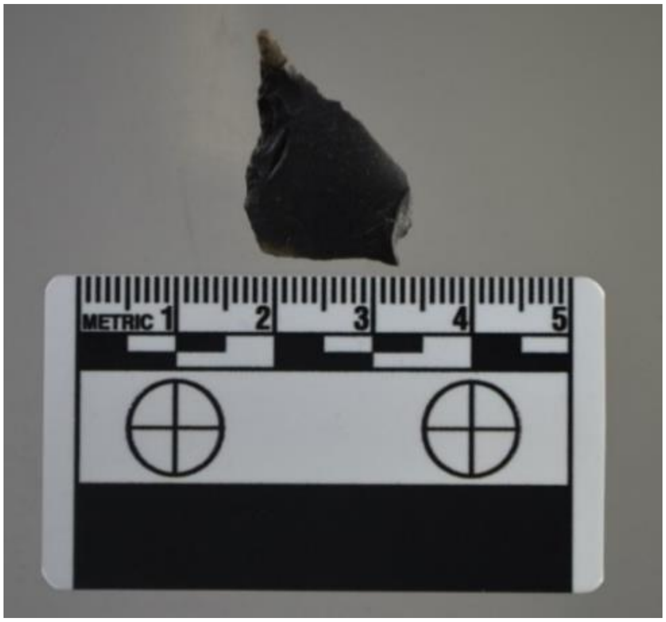


Figure 5.13: Example of Pointed Retouched Flake Tool from Late Archaic II Component at Mussel Beach

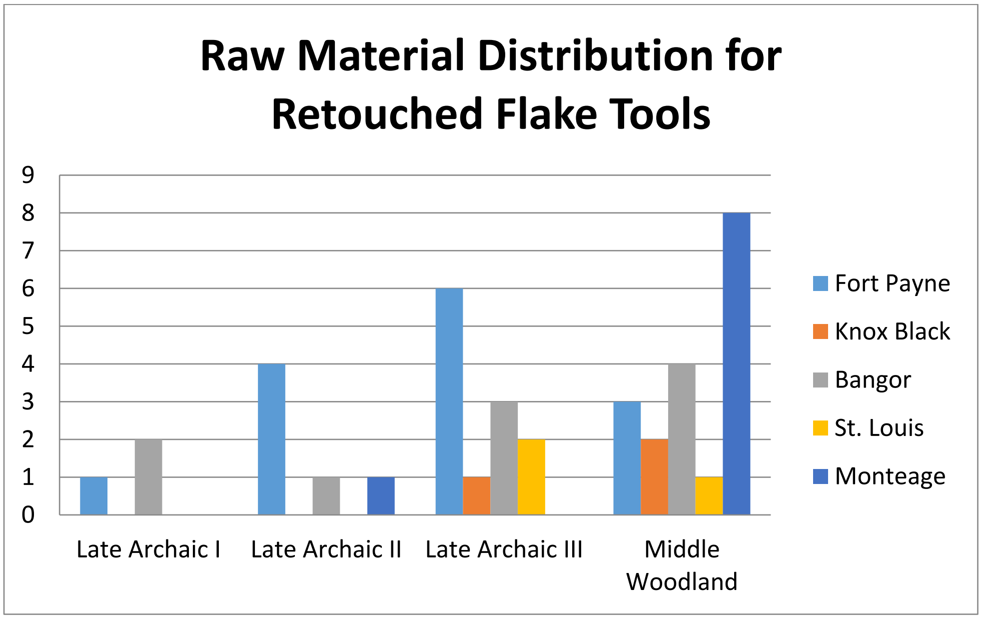


Figure 5.14: Summary of Raw Material Type for Retouched Tools by Temporal Component

from this tool category. In general, there is a reduction in the types of chert utilized for the retouched tools, with a much greater emphasis on the local Monteagle-Bangor chert types. When comparing the use of raw material types between the use-modified and retouched tools using a Chi-Square (Table 5.37), the results are not statistically significant (Table 5.38). A Chi-Square test of independence was also used to test the relationship between raw material type and temporal component for the retouched flake tools (Table 5.39). The results revealed that there was no significant difference between the types of chert utilized for retouched tools between temporal components (Table 5.40).

The assemblage of retouched flake tools contain varying amounts of dorsal cortex. The assemblage contained 6 (15%) “Primary Decortification” flakes, 11 (28 %) “Secondary Decortification” flakes, and 22 (56%) “Tertiary” flakes. Based on the relative amount of dorsal cortex, the flakes utilized as retouched specimens were derived from all stages of lithic reduction. In general, however, flakes lacking cortex were dominant in the assemblage of retouched tools. At 56%, the percentage of tertiary flakes utilized for retouching is comparable to those of the use-modified flakes. While it was hypothesized that dorsal cortex might have been preferred as a form of natural backing, the assemblage of retouched flake tools contained only a few specimens where the cortex would have served this purpose. In general, it appears that tool users preferred to retouch flakes with little to no cortex. When the relationship between dorsal cortex and retouched flakes is examined between temporal components using a Chi-Square test of independence (Table 5.41), the results are not statistically significant. Differences in the percentage of dorsal cortex on flake tools may be related to user preference, raw material availability and size, as well tool function.

The number of dorsal scars on the retouched flake tools also indicates that flakes were

Table 5.37: Chi-Square Test of Independence for Raw Material Type between Tool Type and Raw Material Type

Tool Type	Fort Payne	Knox	Bangor	St. Louis	Monteagle	Heated	Chalcedony	Unidentified	Totals
Use-modified	50 (55.7)	30 (29.5)	98 (94.0)	16 (14.8)	50 (51.4)	6 (6.1)	4 (3.5)	8 (7.0)	262
Retouched	14 (8.3)	4 (4.5)	10 (14.0)	1 (2.2)	9 (7.6)	1 (.9)	0 (.5)	0 (1.0)	39
Totals	**64**	**34**	**108**	**17**	**59**	**7**	**4**	**8**	**301**

(X^2=9.07, df=9, *P*=.431)

Table 5.38: Results of Chi-Square Test of Independence Comparing Raw Material Type between Use-modified and Retouched Flake Tools

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	9.068[a]	9	.431
Likelihood Ratio	10.485	9	.313
Linear-by-Linear Association	3.817	1	.051
N of Valid Cases	301		

a. 9 cells (45.0%) have expected count less than 5. The minimum expected count is .26.

Table 5.39: Chi-Square Test of Independence Comparing Raw Material Type for Retouched Flakes between Temporal Components

Tool Type	Fort Payne	Knox	Bangor	St. Louis	Monteagle	Heated	Totals
LA I	1 (1.1)	0 (.3)	2 (.8)	0 (.1)	0 (.7)	0 (.1)	3
LA II	4 (2.2)	0 (.7)	1 (1.5)	0 (.2)	1 (1.4)	0 (.2)	6
LA III	6 (4.3)	1 (1.2)	3 (3.1)	1 (.3)	0 (2.8)	1 (.3)	12
MW	3 (6.5)	3 (1.9)	4 (4.6)	0 (.5)	8 (4.2)	0 (.5)	18
Totals	**14**	**4**	**10**	**1**	**9**	**1**	**39**

(X2=20.12, df=18, *P*=.326)

Table 5.40: Results of the Chi-Square Test of Independence for Retouched Flake Tools between Raw Material Type and Temporal Component

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	20.117[a]	18	.326
Likelihood Ratio	23.568	18	.170
N of Valid Cases	39		
a. 27 cells (96.4%) have expected count less than 5. The minimum expected count is .08.			

Table 5.41: Chi-Square Test of Independence for Retouched Stage Flakes between Temporal Components

Component	Primary	Secondary	Tertiary	Totals
LA I	3 (1.7)	0 (.8)	0 (.5)	3
LA II	2 (3.4)	4 (1.7)	0 (.9)	6
LA III	4 (6.8)	4 (3.4)	4 (1.8)	12
MW	13 (10.2)	3 (5.1)	2 (2.8)	18
Totals	**22**	**11**	**6**	**39**

(X2=16.84, df=9, *P*=.051)

selected during all reductions stages. Because of the amount of retouching on several specimens, it was not possible to accurately assess flake scar count on a majority of the retouched tools. During the process of retouching a tool's edge, small flake scars are removed from the working edge, but flake scars may extend beyond the edge into the flakes interior. As a result, it can be difficult to determine the extent of dorsal scarring prior to additional retouching. Of those retouched flake tools in which dorsal scars were counted, the majority contained either no evidence for flake scars (n=9) or only 1 to 2 previous removals (n=11). The remaining flake tools contained 6 or more flake scars, but many were likely produced as a result of retouching. It appears as though tool users were more frequently selecting flakes with either no flake scars or flakes with fewer than 3-5 flakes scars, which might suggest a preference for flakes detached during the earlier stages of reduction. Unfortunately, the striking platforms on the assemblage of retouched tools reveals very little information regarding reduction activities, as 62% of the sample (n=24) lacked an intact or discernible platform. The sample of remaining tools contained only a 1 (3%) abraded platform, 6 (19%) faceted platforms, and 8 (25%) flat platforms. Based on such a small sample size, it is difficult to discern any pattern in flake selection, or to determine the degree to which tool makers directed flake blank reduction.

Formal Retouched Flake Tools:

The tools classified as formally retouched exhibit extensive retouching and edge modification on more than one flake margin, and have been shaped into specific tool forms. While some of these implements may contain retouching on the dorsal and ventral surface, the retouching tends to be more extensive on the dorsal surface and is restricted to the margins on the ventral surface of the tool. Most of these tools, however, are unifacial and do not show evidence of having been bifacially retouched. Because many of these tools have a discernible dorsal and ventral surface, as well remnants of a striking platform, they fall within the flake tool category, but may not necessary be characterized as expedient. The extensive retouching on these artifacts suggests that their manufacture required an investment of time and energy, as well as some design elements. Given that many of the formal flake tools have been shaped into specific tool forms, it suggests that they were designed to complete a particular task, and were not intended to be multifunctional.

The assemblage of formally retouched flake tools at Mussel Beach is small, consisting of only 7 artifacts recovered from the Late Archaic II, Late Archaic III, and Middle Woodland components. Because the flake tools contained extensive secondary modification on the lateral and distal margins, it was not possible to discern flake condition prior to modification. As with the rest of the flake tools, the formal retouched artifacts are rather small, with a mean length of 23.28 mm, a mean width of 10.39 mm, and a mean thickness of 4.45 mm (Tables 5.42 and 5.43). Similarly to the retouched specimens, the mean edge angle for the formal flake tools was 73.33° (Table 5.44). Unfortunately, the sample size for these artifacts is too small to be analyzed statistically.

Of the 7 artifacts classified as formal flake tools, six (86%) were characterized as having pointed edges (Figure 5.15), and the remaining specimens edge is undulating, with both concave and convex portions (Figure 5.16). This artifact is unifacial, but does show evidence for the removal of small flake scars on both the dorsal and ventral surface on at least one flake margin. Based on the morphology, as well as the location of retouching and edge damage, this artifact has been identified as a scraper. All six of the pointed tools have been categorized as drills or perforators, and because of their size, four are characterized as microdrills. These four artifacts show steep retouching on the ventral surface, with modification extending from the distal end along the lateral margins, with intact striking platforms at the proximal end. On one of the six drills the retouching is restricted to one edge and the outline of a drill is apparent, however, the artifact is unfinished and was thus categorized as a drill preform. Similar microartifacts recovered from archaeological sites in the Southeast were found to have been used to perforate shell for the production of shell beads (Johnson 2000). It is possible that the drills recovered from the Late Archaic III and Middle Woodland occupations were used to manufacture beads. While there is currently no direct evidence for shell bead production at Mussel Beach, there are a number of modified shell specimens which exhibit evidence for drilled holes along the shell margins (see Figure 4.9 in Chapter 4). Microscopic usewear analyses of these tools will be

Table 5.42: Mean Length for Formal Retouched Flake Tools (mm)

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Length	7	20.28	29.32	23.2883	3.44567
Valid N (listwise)	7				

Table 5.43: Mean Width and Thickness for Formal Retouched Flake Tools (mm)

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Width	7	5.260	23.520	10.39500	6.802508
Thick	7	3.05	7.83	4.4517	1.71971
Valid N (listwise)	7				

Table 5.44: Mean Edge Angle for Formal Retouched Flake Tools (mm)

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Angle ○	7	60	80	73.33	8.165
Valid N (listwise)	7				

Figure 5.15: Formally Retouched Flakes Identified as Microdrills/Perforators

Figure 5.16: Formal Retouched Scraper from Mussel Beach Site

discussed in Chapter 6.

The raw materials utilized for the Formal Retouched tools include Bangor (n=3; 43%), Fort Payne (n=1; 14%), Knox (n=1; 14%), and Monteagle (n=2; 29%). These appear to be the most frequently utilized types of chert throughout each temporal component at Mussel Beach, and it is currently unclear if there is a relationship between these types of tools and raw materials selected. With respect to dorsal cortex on the formally retouched tools, three of the six artifacts retain at least some cortex, but it is limited primarily to the striking platform. Because many of these tools have been heavily retouched, it is difficult to determine their place in the reduction sequence or the types of cores from which they were detached.

5.5 Summary of Flake Tool Morphological and Technological Data

The analysis of the lithic assemblage from the Mussel Beach Site was extensive, involving the examination of 28,132 pieces of lithic debris in search of utilized flake specimens. Each artifact exhibiting edge damage was analyzed using criteria established to eliminate flakes whose damage was not the result of use or intentional retouching. Of the 924 flakes analyzed under a low-power Stereoscopic microscope, only 489 (53%) showed definitive evidence of use. From this sample, however, only 314 flake tools contained provenience information and thus were selected for further analysis. The six tools associated with the Late Woodland cultural component were also eliminated from further analysis because the component itself was reported as being only partially intact (Gregory et al. 2011), and the sample size was too small to be statistically significant. The remaining assemblage of flake tools (n=308) were grouped into typological categories based on the extent and location of edge damage.

In total, 262 (85%) flakes were classified as use-modified, 39 (13%) were classified as retouched, and 7 (2%) were categorized as formally retouched artifacts. Overall, the flake tools were relatively small in size and generic in shape. In the previous section I presented information describing tool morphology, but did not necessarily address flake blank selection with regard to the entire debitage population. I hypothesized that flake blanks were likely selected for use based on some morphological or technological characteristics, of which size is often a motivating factor. In order to explore the dimensional variability between flake tools and the non-tool debitage assemblage, I plotted three general flake dimensions (maximum length, maximum thickness, and maximum width) using a simple 3-D scatterplot (Figure 5.17). By plotting flake tools and non-utilized debitage together, it becomes apparent that flakes of varying proportions were considered to be suitable for use as tools. While there does appear to be extensive overlapping of the plots, a comparison of mean flake tool dimensions for utilized flakes and non-tool debitage indicates that there was some degree of selection bias for flake blanks from within the greater debitage assemblage during each temporal component (Table 5.45). In general, flakes selected for use as tools were longer, wider, and thicker than non-tool debitage. It is probable that the chert nodules available for knapping were never very large,

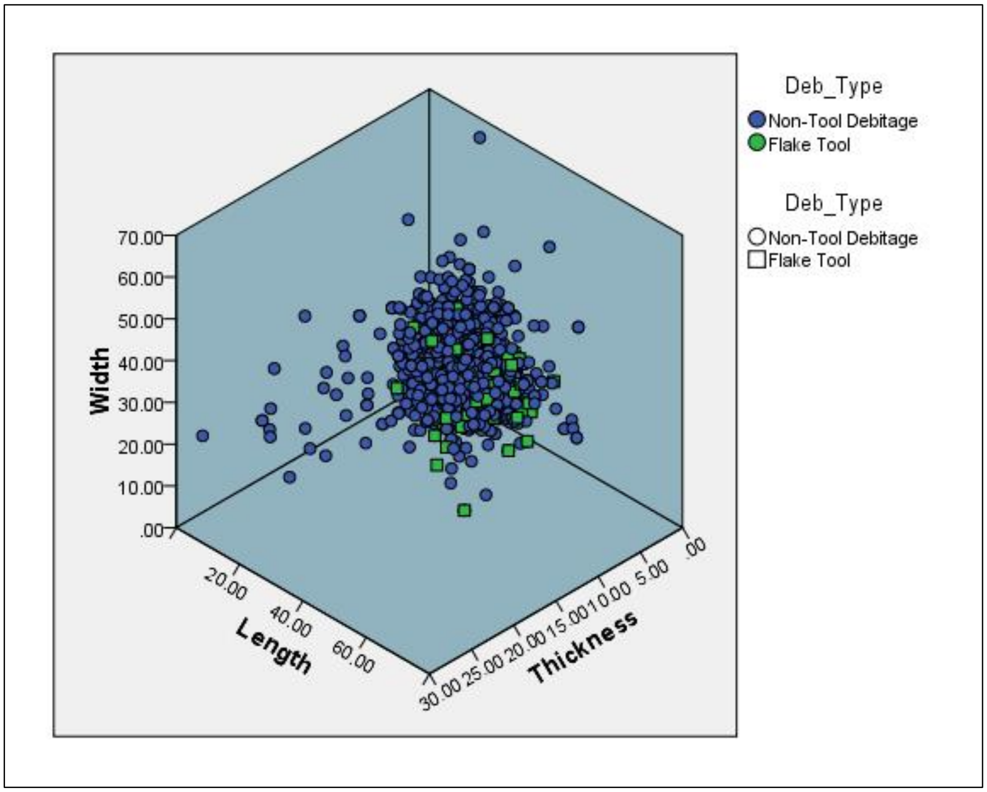


Figure 5.17: 3-D Scatter Plot Showing the Distribution of Flake Tools and Non-tool Debitage based on Mean Length, Width, and Thickness

Table 5.45: Comparison of Mean Length, Width, and Thickness for Non-tool Debitage and Flake Tools

Component	Tool Type	Length (mm)	Width (mm)	Thickness (mm)
LA I	Non-tool Debitage	20.59	16.19	3.61
	Flake Tools	25.81	16.66	4.06
LA II	Non-tool Debitage	19.32	15.96	3.28
	Flake Tools	24.26	17.11	3.78
LA III	Non-tool Debitage	20.37	18.67	3.39
	Flake Tools	24.49	16.09	4.42
MW	Non-tool Debitage	18.56	16.38	3.3
	Flake Tools	21.99	16.76	4.68

which means that the debitage produced would be limited in size. It would not be suprising, then, to find that the largest of the flakes detached during core reduction were utilized as tools. Even though size was restricted, there was still considerable variation between tool categories and temporal components, which suggests that flake blanks were not selected based on any particular morphological characteristics.

Based on the results of the morphological and technological analyses, it was determined that use-modified and retouched flake tools were produced during the full range of lithic production activities, from initial early stage core reduction through late stage bifacial thinning. The flake tools, which were all moderate in size, exhibited a wide range of morphological characteristics. When utilized without intentional retouching, tool users tended to select complete flakes over fragments and angular shatter. The majority of the use-modified tools contained straight working edges which could have been utilized for a wide range of tasks. Overall, the tools lack design and were therefore not likely intended to be used for tasks requiring specialized implements. While the mean edge angle for use-modified flakes was 54.29°, the assemblage contained flakes with edge angles measuring between 15 and 80 degrees.

By combining edge angle information with flake scar orientation and flake scar location, it was possible to also evaluate tool function, however this is only in relation to use-action and hardness of materials worked. Of the 262 use-modified flakes identified, 195 (73%) displayed evidence for transverse motions, 44 (17%) appeared to have been used in a longitudinal direction, 20 (9%) of the flakes show evidence for both transverse and longitudinal actions, and 3 (1%) artifacts contained use evidence that was characteristic of neither direction type. With respect to contact materials, it was determined that the use-modified tools were in contact with a wide range of material types (Figure 5.18). The extent, however, to which these tools were used

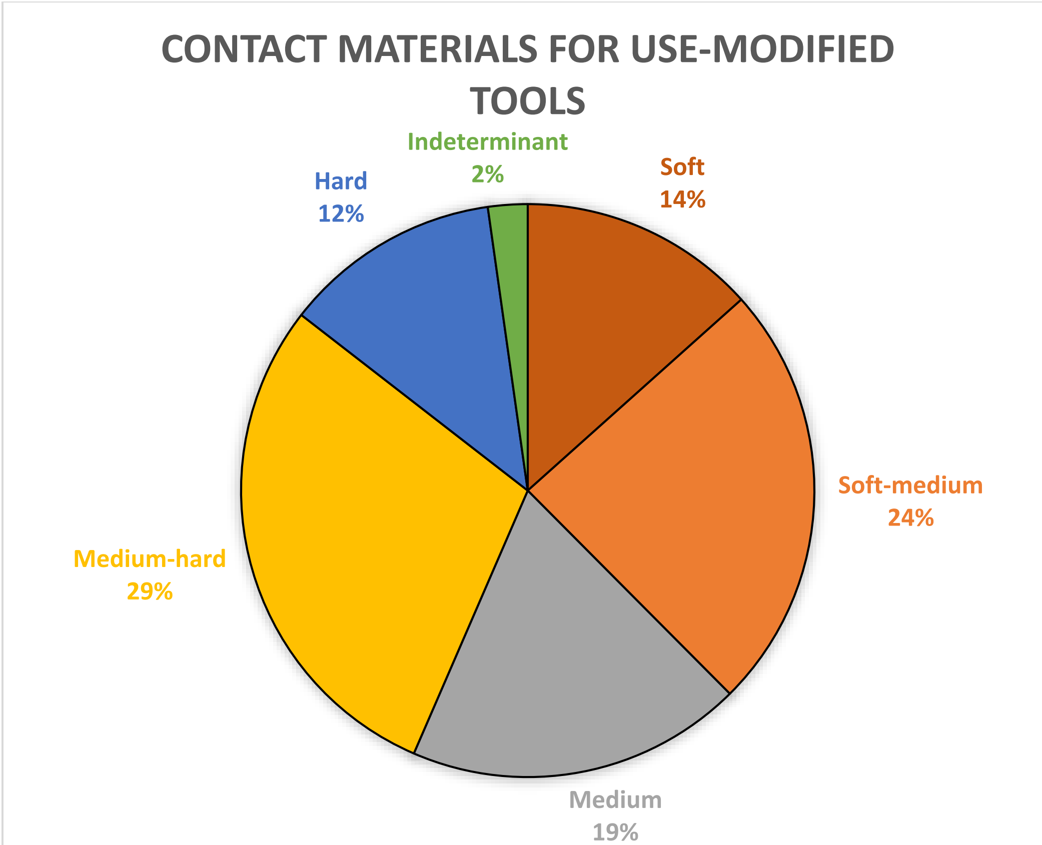


Figure 5.18: Summary of Contact Materials for Use-Modified Tools from Mussel Beach

cannot always be determined using low-power microscopy. The lack of retouching suggests that these tools were utilized to fulfill an immediate technological need, and were discarded shortly after use. With chert sources available at and near Mussel Beach, the use-life of flake tools was short-lived, as tool users could easily have selected a fresh edge rather than retouching an exhausted one. Evidence for hafting is also absent on the assemblage of use-modified flake tools, which indicates a lack of curation associated with flake tool technology. The use-modified flakes, however, do exhibit fracture scars on flake margins opposite the working edge, suggesting that they were grasped in the hand during use.

The retouched flake tools, or those specimens that were subjected to secondary modification, were more commonly associated with flakes that were either fragmented or broken, but the general pattern of flake selection indicates a preference for complete flakes. In many cases it was obvious that the flake had been broken prior to use, as the retouching was often located within the broken portion of the tool. It is unclear, however, whether the flake had been broken purposefully or if it occurred naturally during the reduction process. The retouched flake tools ranged from those with minimal modification in the form of small notches, to more extensive modification, wherein the edge(s) had been deliberately shaped to reflect the tool makers' desire for a specific tool form. The retouching of flake blanks, specifically those resembling drills, perforators, burins, and spokeshaves suggests that the tools were being retouched to complete tasks in which a specific type of working edge was necessary.

While retouching of a flake's edge was often used to produce a functional edge, there is also evidence to suggest that many of the retouched portions were modified for hafting and/or prehension. Hafting of the retouched flake tools may suggest a certain level of curation, however it is more likely that it was necessary to improve the tools function, and not increase its uselife. Overall the degree of edge modification on the retouched flake tools indicates that the majority of these artifacts were not intended to be curated or recycled, but were still considered to be situational and expedient.

The analysis of the retouched flake tools under low-power magnification found that 18 (46%) of the tools were used in a transverse motion, 1 (3%) was used in a longitudinal direction, 8 (21%) show evidence for both transverse and longitudinal actions, and 12 (31 %) contained damage or retouching that made it difficult to interpret use action. Actions such as grooving, graving, or planning often involve longitudinal and transverse motions, although evidence for such activities might not always be discernible. Similarly when an implement is used as a perforator, or in a projection type motion, the edge damage is restricted to the tip. Edge damage may not always be present on such tools, especially if the tool is not used repetitively or for long periods of time or if the tops were damaged during use. With regard to contact materials, the retouched flakes were also used on a wide range of materials (Figure 5.19). The number of specimens in which a contact material could not be identified does increase with this assemblage of tools. Edges with extensive retouching are often difficult to classify by use under low-power magnfication, as the retouching can often resemble use damage. Further complicating the identification of contact material is the condition of the tool itself. In some cases, for example, the distal end of the retouched drill tools were broken, making it difficult or impossible to discern what the tool might have been in contact with.

Overall, the use-modified and retouched flake tools were manufactured from various types of local raw materials and were not frequently produced on heat treated cherts or non-local chert sources. Between each of the cultural occupations at Mussel Beach, there were some differences in flake blank selection based on raw material type, however there was still an emphasis on local resources. The flake tools exhibited minor evidence of platform preparation, which suggests that the removal of flake blanks from cores was not intended to produce flakes of a particular shape or size, but was perhaps aimed at generating a wide range of flakes types suitable for a variety of tasks. Core types were likely to be amorphous and bifacial, both of which are known to characterize lithic assemblage recovered in source areas and both of which are found in the Mussel Beach lithic assemblage (Johnson 1989). While there is direct evidence that bifacial production was one of the primary goals of the core reduction activities taking place at Mussel Beach, it is also probable that at least some of the core reduction activities were intended to amass flakes which could then be utilized as tools.

The formally retouched flake tools comprise only a small portion of the total flake tool

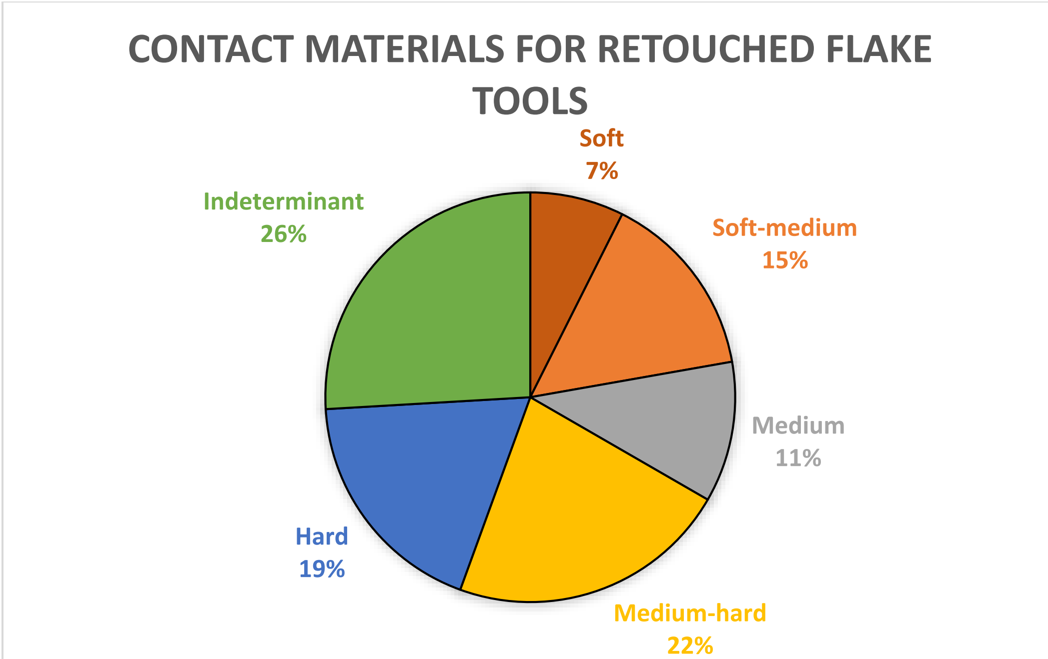


Figure 5.19: Summary of Contact Materials for Retouched Flake Tools from Mussel Beach

assemblage found at the Mussel Beach Site. Of the five tools identified, four exhibit extensive edge modification on two lateral margins which effectively create a pointed tool edge. Based on their morphology, these artifacts have been tentatively identified as microdrills or microperforators. It is not uncommon for these types of tools to have been hafted for use, although direct evidence for hafting on these artifacts is limited. Similar artifacts recovered from archaeological sites in the Southeast and contexts outside this geographic region, have found that these types of tools were frequently used in the production of shell, bone, antler, ceramic, and stone beads (Coşkunsu 1993; Johnson 2000; Masucci 1995; Yerkes 1983). Although a singular stone bead was recovered from the Mussel Beach site, direct evidence for shell bead manufacturing has yet to be identified at this location. It is premature, however, to rule out shell bead manufacturing, given the abundance of raw materials available and the large assemblage of culturally modified shells, of which drilled specimens were identified. In order explore this further, it would be necessary to examine the entire collection of shell found at Mussel Beach, as well as the heavy fraction material. Mixed into the shell debris could not only be complete beads, but shell beads in various stages of completion. Additionally, within the artifact assemblage should be tools used to smooth and shape the rough cut beads into their desired form. Lithic abraders were known to serve this function, although grit and sand-tempered ceramics have also been found to be effective abrading instruments (Pearson and Cook 2012: 94). Although is it assumed that the microdrills/perforators functioned as such, the low-power analysis resulted in limited use-related information, and could not be used to determine use action or exact contact material.

In this chapter I provided an overview of the data collection process and typological scheme that was used to identify and classify the assemblage of flake tools from the Mussel Beach Site. Preliminary functional interpretations were also reported based on the results of the low-power microscopic analysis. In the next chapter, I provide a brief overview of the history and techniques associated with high-power microscopic analysis and also include the results and functional interpretations for the flake tool assemblages recovered at Mussel Beach.

Chapter 6: High-power Lithic Functional Analysis: History, Methodology, and Results

Lithic functional analyses have played an important and fundamental role in the interpretation of archaeological sites. Such analyses not only provide information related directly to the function of individual artifacts, but they also allow archaeologists to address other aspects of past human behavior, including the spatial and gendered organization of activities, and changes associated with social, economic, and technological behaviors. In this chapter, I present a historical overview of high-power functional analysis and discuss the various methods and analytical techniques associated with this approach. I also provide descriptions and categories of microwear evidence and discuss how these wear patterns help archaeologists derive functional interpretations of prehistoric tools. Included in this chapter are descriptions of the methods I used to analyze and quantify the wear patterns observed on the flake tools from the Mussel Beach site, as well as the experimental tools used during the ethnoarchaeological component of this dissertation. I provide the results of the functional analyses for both the experimental assemblage associated with cane processing and the archaeological specimens from the Mussel Beach site. I conclude this chapter with a discussion of functional trends for flake tool use over time.

6.1 High-power Functional Analysis: A History

Approaches to stone tool analysis have ranged from behavioral concerns, to those emphasizing the procurement, use, and manufacture of stone tools. The primary goal of lithic analysis is to better understand aspects of prehistoric lifeways, including subsistence practices, settlement and mobility patterns, and adaptations to the natural environment (Yerkes and Kardulias 1993). To address these issues archaeologists have studied and categorized stone tools based on technological and morphological characteristics, as well as tool function. Prior to the development of functional analyses, tool function was determined by tool form or morphology. Function was also assigned to tools by way of ethnographic analogy; wherein observations of stone tool use among contemporary cultures were used as proxy to identify and classify prehistoric stone tools (Andrefsky 1998; Bindord 1978; Cotterell and Kamminga 1979; Rots and Williamson 2004; Weedman 2010). While ethnographic observations have proven useful, there are limitations in its application to archaeological assemblages. Of primary concern are those variables which cannot be observed in modern contexts, including, but not limited to, environmental and climate changes, population pressure, economic and political stability, and subsistence stress. Prehistoric people were continuously adapting their lifeways to perceived environmental, social, and economic stresses, and it can often be difficult to understand how technology would have been affected. It is important, therefore, to recognize that activities observed ethnographically may not represent the full range of tasks with which prehistoric tools and peoples may have been engaged. With that being said, ethnographic and ethnohistoric observations of stone tool use and manufacturing have allowed archaeologists to observe a range of activities and contexts in which stone tools are used, and these observations have served to strengthen use-related interpretations.

As noted in Chapter 5, Russian born archaeologist, Sergei A. Semenov, is credited with revolutionizing the study of lithic artifacts. By analyzing experimentally used tools under low-power magnification, Semenov was able to document specific use-related wear patterns and edge damage (Yerkes and Kardulias 1994:100). He was one of the first lithic analysts to describe and document different kinds of microwear with magnified photographs (Tringham et al. 1974:175). Semenov's photographs magnified the edge damage and diagnostic features on tools that resulted from different use contexts. The English translation of Semenov's seminal work, *Prehistoric*

Technology, was published in 1964 and has been used by American archaeologists to develop additional methods of functional analysis (Ahler 1971; Gould 1971; Keely 1980; Odell 1980; Tringham et al. 1974).

While Semenov (1964) is credited with developing the methods of usewear analysis, archaeologists first began noting the presence of wear on stone tools in the late 19th century. Greenwell (1865), for example, noted the formation of polish on endscrapers and hypothesized that they had been used to dress hides (as cited in Kooyman 2000:152). In 1872, English-born archaeologist John Evans observed distinctive wear traces on stone tools and performed experiments on use damage using a variety of retouched flakes, scrapers, and knives. Often regarded as the "Father of Microwear Analysis", Evans observed that certain actions, like scraping, produced microfractures that were oriented perpendicular to the working edge (Kooyman 2000:152). He also noticed that tools of a similar shape do not always function in the same way, and similar wear patterns observed on stone tools could be the result of a variety of actions (Vaughn 1981:12).

Early studies addressing the formation of sickle gloss and plant polish include Spurrell (1892), who noted a distinctive polish on sickle blades, Rau (1869) who described polish found on the bits of prehistoric hoes, and Vayson (1919), whose experiments with wood working and the processing of cereal resulted in the formation of visible polish (Kooyman 2000; Vaughn 1981; Yerkes and Kardulias 1994). What distinguishes these early attempts at functional analysis from those developed by Semenov, is that they relied almost exclusively on the macroscopic identification of wear and based functional interpretations on tool morphology.

While macroscopic observations and low-power microscopy can be used to determine tool function, these methods cannot be used to identify specific contact materials. As mentioned in Chapter 5, Lawrence Keeley (1980) found that when lithic artifacts are observed under higher magnification, additional types of wear become visible and quantifiable. Keeley was able to not only observe linear striations and micropolish, but was able to document the subtle changes associated with their morphology and topography (Keeley 1980; Yerkes and Kardulias 1994). By documenting the types of edge wear that resulted from experimental use and then comparing the specimens to archaeological samples, Keeley found that it was possible to differentiate between contact materials based on their hardness. Keeley also found that the microwear that developed from working certain raw materials was so distinct that he could also differentiate between specific worked materials (e.g., bone, hide, wood, flesh, plant).

The traditional high-power approach utilizes a metallurgical binocular microscope with incident light. These microscopes commonly come equipped with 10x, 20x, and 50x objectives and often use 10x oculars to provide 100, 200, and 500 power magnification (Keely 1980; Kimball 1995). The incident light microscope employs a system of illumination wherein light is transmitted though the objective lens at almost a direct angle. The nature of this kind of illumination allows one to observe subtle changes in the microtopography and surface texture (Kimball 1994). Others (Borel et al. 2014; Ollé and Vergés 2014; Pedergnana and Ollé 2017; Tumung et al. 2015; Morales and Vergés 2014) have employed a scanning electron microscope to complete high-power analysis, since the identification of polish relies on the reflection of light. While the SEM cannot reliably identify polish or exact contact materials, it can address and document changes in the tool's topography and surface texture and questions regarding the formation of striations and some residue. This method does require that all specimens be coated in gold and mounted to a specimen stub for observation within a vacuum chamber. Because of the use of the vacuum chamber, artifacts selected for analysis are limited by size, as they must fit within the chamber for analysis.

A more recent development in high power analysis utilizes laser scanning confocal microscopy (LSCM) to produce 3-dimensional point data on individual artifacts that can be presented as a high resolution image or as quantitative data (Stevens et al. 2010). The images produced with LSCM are "high focal depth color images" that contain topographic surface data (Evans and Donahue 2008:2226). Evans and Donahue (2008) demonstrated that the LSCM approach produces images wherein polishes appear to be quite distinct from one another. The process essentially makes usewear analysis more quantitative, and allows analysts to represent usewear data in the form of probability statements that includes not only how the tool was used, but also information on certain attributes (Stevens at al. 2010). This method is often more advantageous than SEM because specimens do not require mounting and are not limited by size requirements. While LSCM is regarded as a promising approach, Stevens et al. (2010) stress that conventional methods of usewear analysis are still valuable resources for collecting data and interpreting tool function.

Overall, the high power approach is a much more time consuming method than low-power microscopy. The process of identifying polish types and striation morphology must be learned and requires at least some work with experimental reference collections in order to become familiar with various types of damage. Also, the high level of magnification requires that the artifact be mounted upon examination, which means that the analyst is only able to view a portion of the artifact at any one time, and the artifact must be repositioned on the mount in order to examine it in its entirety. The most significant problems related to usewear analysis in general, however, are related directly to the formation of edge damage or usewear. There is, for example, rarely agreement between analysts regarding discrete usewear, damage patterns, and their relationships to a specific contact material. It has been demonstrated that the formation and appearance of polish has the potential to be effected by many factors, including various post-depositional processes. Different post-depositional processes may produce edge damage and polish on lithic artifacts that mimic use damage, or conversely obliterate or significantly alter edge damage, polish, and striations (Levi-Sala 1986). Some of the most detrimental processes include trampling, chemical and mechanical weathering, excavation and curation methods, and various cleaning techniques (Berry and Bamforth 1989; Grace et al. 1985; Plisson and Mauger 1988; Levi-Sala 1986; Tringham et al. 1974).

The formation of polish is also greatly dependent upon lithic raw material and, more importantly, duration of use. Shea (1987) and Hurcombe (1998) have found that weaker polish formation is often indicative of early stages of use, or a limited use of that particular tool. The hardness of both the material worked and lithic raw material also plays a significant role in the formation of polish. Tools used on softer materials, like plants, develop polish at a much slower rate compared those used on harder materials like bone or antler (Knutsson 1988). Coarser raw materials, such as some types of quartzite, also tend to develop polish and wear at a much slower rate when compared to highly siliceous cherts. This disparity between the formation of polish often results in certain activities being underrepresented in relation to tool use on different materials from archaeological samples (Olausson 1990:9). Grace (1996) also points out that there can be a certain degree of overlap between polishes present on a tool's surfaces, and the identification of polish can be quite subjective. In fact, critics have argued that if micropolishes were discrete and material specific, then there should be a way to systematically quantify or describe them in an objective way (Yerkes and Kardulias 1994). Grace (1996) has suggested that analysts consider polish formation as a continuum, rather than as discrete and specific to a particular material. While many of the criticisms associated with this high-power approach have been addressed and in many cases refuted, analysts continue to seek new ways to improve methodology and functional interpretations.

Blind-tests are often utilized in usewear analysis as a means of testing the objectivity, knowledge, the skill of the analyst, and the efficacy of different analytical methods (Newcomer et al. 1986; Rots et al. 2006; Odell and Odell-Vereecken 1980; Young and Bamforth 1990). Blind tests are essentially exercises in which experimentally manufactured and used tools are examined by specialists to test the accuracy of the information derived from the analysis. Results of these test vary considerably, with an average accuracy at 47.2 % (Evans 2014:6). This demonstrates that it is not always possible to accurately identify the nature of use of stone tools. Young and Bamforth (1990) concede that one of the primary reasons that tools are misidentified is that the analyst has not considered the full range of processes which affect artifacts throughout their uselife or after discard. Evans (2014) argues that blind tests should not be seen as just a means to critique functional analyses, but rather can be used to enhance methodologies. The importance of blind tests lie in their ability to identify problematic areas in current usewear techniques and understand which areas of the method can be improved upon (Evans 2014:13).

To overcome many of the challenges associated with usewear analysis, including observer error and objectivity, many analysts advocate for a multi-approach that combines low and high-power approaches with experimental reference samples and blind tests (Evans 2014; Keeley 1980; Marreiros et al. 2015). Each method provides information with respect to tool function, and when combined they offer a more complete picture of tool use. The methods utilized to determine tool function should be complementary, with each adding significantly to the overall interpretation of prehistoric stone tools.

6.2 High-power Analysis: Characterizing and Recording Use-related Wear

In Chapter 5 it was noted that usewear and edge damage on stone tools produced during use falls into five distinct categories: microfractures, striations, rounding, micropolishes, and residues. The formation of each type of wear is dependent upon a number of variables, including differential friction and resistance of material worked, hardness and elasticity of both the raw materials and worked materials, duration of use, edge angle and edge morphology, and the amount of applied pressure (Keeley 1980; Odell and Odell-Vereecken 1980, Tringham et al. 1974; Vaughn 1981). In Chapter 5 I also described the formation and development of microfractures and their use in determining relative use actions and materials worked. In this section, I discuss the development and characterization of striations, polish, and edge rounding. Residue analysis will not be discussed because it was not performed on any of the artifacts from the Mussel Beach lithic assemblage.

Striations:

Striations have been defined as linear grooves, or scratches that form on a tool edges as loose particles are compressed or abraded onto the surface during use (Kooyman 2000; Shea 1992:143). Loose particles can consist of foreign particles, such as grit or sand, microflakes, or pieces of the material worked (e.g. phytoliths). Many analysts (Keeley 1980; Kooyman 2000; D'Errico 1988; Vaughn 1985) have attempted to characterize striations according to their width, depth, quantity, and general morphology. Experiments have shown that the depth of a striation is a result of a combination of hardness of the raw material and the amount of pressure exerted on loose particles. The width of a striation depends on the size of the loose particles that are being compressed or abraded into the surface (Kooyman 2000). With that being said, analysts have not developed a standardized terminology for characterizing striation types, and the descriptions of striation types can vary considerably between analysts. Kooyman (2000:159), for example, identifies four types of striations: rough bottomed, smooth bottomed, additive, and infilled. Keeley (1980) also describes four types of striation, but proposes the use of the following descriptions: narrow deep, narrow shallow, broad deep, broad shallow. D'Errico (1988) provides yet another typology for striations, describing them as protuberant, comet-like, and stretched. The use of these classification schemes likely depends on the analysts training as well as personal preference.

In order to be consistent, the characterization of striations on the Mussel Beach lithic artifacts follow those described by Vaughn (1985:24). Based on his experimental collections, Vaughn (1985:24) identified three broad classes of striations: deep, superficial, and directional indicators. Vaughn did not attempt to further characterize deep or superficial striations because he found that neither were associated with a particular category of material worked (Vaughn 1985:25).

- **<u>Deep striations</u>:** Striations characterized as being deep exhibit depth, in that they appear to be physical scratches or grooves in the stone surface when viewed microscopically.
- **<u>Superficial striations</u>:** Superficial striations, in contrast, are not engraved within the stone, but instead appear superimposed within patches of polish. Superficial striations may appear as streaks of polish oriented in a single direction.
- **<u>Directional indicators</u>**: Directional indicators are defined as features integrated onto the tool surface which point to the direction of tool motion.

In most cases, striations or features oriented perpendicular to the working edge, indicate a transverse motion (i.e., scraping), while striations parallel or diagonal to the working edge indicate longitudinal actions (i.e., cutting). Similarly to microfractures, striations may be confined to a single tool surface when the tool is used in a scraping motion, but may also be present on the ventral and dorsal surface of a tool edge when used in a longitudinal motion.

Through his experiments, Vaughan (1985) found that the formation of striations varied between contact materials. The working of harder materials, for example, frequently resulted in the formation of striations. The striations were produced as microflakes, which were detached during use, became compressed and abraded into the surface. Soft materials, in contrast, produced minimal microflakes, which resulted in the formation of fewer striations. The production of striations, their morphology, intensity, and orientation can provide information on the hardness of the worked materials as well as the motion in which the tool was used. It should be noted, however, that striations also result from non-use actions, including soil movements, subsoil pressure, percolating water, trampling, and screening when substantial amounts of grit or soil are present (Vaughn 1985:25). Vaughn (1985) has observed, however, that non-use striations tend to be more random and intersecting, and that orientation will depend upon the mechanism which produced them. Use-related striations also tend to be concentrated on the active tool edge, while non-use striations can extend beyond the tool edge onto the surface of the tool, often occurring within flake scars and along ridges on the dorsal surface of the tool. While striations caused by non-use factors are identifiable, it is suggested that analysts not depend on striations alone to determine the principal tool motion, but continue to incorporate additional lines of evidence.

Rounding:

Experimental studies have shown that the prolonged use of a tool can result in the abrasion, dulling, or rounding of a tool’s edge. The location and extent of rounded edges on an artifact can attest to the degree of loading, duration of use, as well as tool motion. Experiments have shown, for example, that when tools are used in transverse motions at a moderate angle, rounding occurs on the contact surface, but when the contact angle is steeper, rounding may appear on both the dorsal and ventral surfaces of the active, or utilized, edge (Vaughn 1985:26). Rounding also may appear on both surfaces of the active edge when tools are used in longitudinal motions.

Intense rounding of an edge is usually indicative of prolonged use, however experiments have demonstrated that the nature of the contact material and the raw material, as well as the natural environment, affects the degree of rounding. The use of an edge on softer materials, like hide for example, are shown to produce rounded edges more frequently than hard materials (Vaughn 1985). While this is often the case, it should be noted use-related activities occurring in environments with greater amounts of foreign particles, like grit or sand, may expedite rounding on a tool's edge. Additionally, coarse grained materials, that are less susceptible to other forms of edge modification, become rounded at much slower rate than fine-grained materials (Vaughn 1985). As with other forms of usewear, rounding can also occur as the result of non-use activities. Fluvial activity, trampling, and the movement of artifacts within their depositional environment can all contribute to some degree of rounding (Tringham et al. 1974). Distinguishing between use and non-use related wear will depend upon the location and extent of rounding on both the active edge and surface of an artifact. Edge rounding on the Mussel Beach artifacts and experimental tools was recorded as being present or absent. If specimens exhibited an extreme form of edge rounding it was also noted.

Polish:

Polish, which develops as the result of use, refers to the light-reflective surface of a tool that is brighter in comparison to the surrounding tool stone (Kooyman 2000:156; Rots 2005). Micropolishes effectively change not only the reflectivity of the stone tool's surface, but also the topography (Jeul-Jensen 1988:55). While the origin and formation of polish has been debated, it is generally agreed that it is produced as a result of chemical and mechanical reactions (Anderson-Gerfaud 1980), or "a combination of abrasion (removal of material) and deposition of silica (taken into solution from the tool surface and any silica in the worked material)" (Kooyman 2000:156) during use. The detached microscopic silica particles, and microscopic pieces of flint, are recompressed and embedded onto both the tool surface and worked material during active loading. The friction and abrasion which occurs during use, produces observable changes in surface microtopography, including the smoothing of higher points of the utilized tool edge, which essentially results in a more reflective surface (Shea 1992:144). The degree of silica content, duration of use, raw material, and material worked affect polish formation, resulting in observable differences in polish brightness, topography, and distribution. During use, polish tends to form in small localized or linked patches along the tool's edge, and this generally allows analysts to identify which of the edges of the artifact was utilized.

The texture, brightness, morphology, and topographic features of polish may also reveal what type of material was worked, but the correct identification has been criticized in the past as being subjective (Grace et al. 1996). Recognizing distinctive polishes depends greatly on experimental programs and the creation of comparative collections. It is equally important for analysts to become familiar with various types of raw materials and unmodified tool stone, as texture, grain size, and natural inclusions will appear different under high-power magnification. Vaughn (1985) notes that fine-grained chert and flint usually appear more homogenous under high magnification, with few discernible crystals or light-reflective patches. Medium-fine grained raw materials displayed some reflective patches that were brighter than the surrounding matrix. Anomalously large quartz crystals should be distinguishable from use-related polish based on their geometric appearance, but natural bright spots present within stone can be misidentified as weak, or poorly developed polish if the analyst is not familiar with the natural properties of the raw material (Vaugh 1985:27).

Experiments conducted by Keeley (1980), Vaughn (1985), and others (i.e., Gendel and Purnay 1982; Sussman 1988; Unger-Hamilton among others), have resulted in detailed observations, identification, and recording of polishes that developed as the result of varying uses. Through the process of experimentation, analysts have been able to record in great detail, polish features and diagnostic characteristics, which has ultimately allowed other analysts to make functional interpretations on archaeological specimens. Vaugh (1985) finds that distinctive use-related polish can generally be distinguished by differences in their reflectivity, surface texture, volume, surface features, degree of linkage, and the extension of polish beyond the working edge (1985:27). Isolated patches of polish should be considered suspect, as they may be either natural bright patches or related to non-use damage. Despite relative differences in grain size, experiments (see Vaughn 1985) have demonstrated that diagnostic features associated with polish are constant in regard to material worked. The primary difference with regard to grain size and polish formation relates to use time. A longer use time is required for the formation of polish on medium and coarse-grained flints, compared to finer-grained flints, which require a relatively shorter use-time (Vaughn 1985:27-28). The extent and development of polish may also differ, as coarser-grained flints tend to exhibit less overall linkage between polish components, unless the edge is used for prolonged periods of time. Fine and medium-grained flints, in comparison, develop polish much more quickly and to a greater extent.

The development of use-related polish on a working edge is believed to develop in three stages, beginning with a generic or weak polish, developing into a smooth-surfaced polish, and lastly forming well-developed polish with diagnostic surface features (Vaughn 1985:29). The active edge of a tool may exhibit one, or various stages of polish development depending on duration of use, contact material, and tool stone. When polish was observed on lithic artifacts from the Mussel Beach collection it was first recorded to reflect one of three stages.

- **<u>Generic Polish</u>:** Generic polish has been described as "dull and flat" with a surface texture that is rough or slightly terraced in comparison to the surrounding surface (Vaughn 1985:28). Generic polish is generally only slightly brighter than the surrounding matrix and lacks the volume associated with more developed types of polish. It forms relatively quickly during use and tends to be distributed in small localized patches on the immediate edge of the tool. It develops from all contact materials, and thus cannot be linked to any particular material worked, but is generally a good indication that they tool has been used.
- **<u>Smooth-pitted Polish</u>**: The second stage in polish development is associated with a smooth-surfaced polish. The smooth aspect refers to the individual polish components with smooth surfaces, however the smooth components may be interrupted by small depressions, cavities, or pits of variable sizes. This results in the incomplete joining of polish patches, leaving dark interstitial spaces (Vaughn 1985:29). Because of these depressions, or pits, this polish is also referred to as smooth-pitted. Similarly to generic polish, smooth-surfaced and pitted polish develops on tools used to work a variety of materials. Subtle differences may be

observed in the degree of pitting and linkage. The size and overall volume of polish areas may also vary depending on material worked, the duration of use, and the intensity of tool use, however these differences are not enough to differentiate between contact materials. If use continues once this polish has developed, this stage will not last very long, as prolonged contact increases the probability that it will develop into a diagnostic polish type.

- **Developed Polish:** The third and final stage in polish development results in the further linking of polish components and the formation of polish with diagnostic surface features (Vaughn 1985:29). Diagnostic polish typically forms in the areas with the greatest contact on tool edges, including the immediate edge area and areas with higher surface elevations. If contact is prolonged or intense in nature, polish can develop on interior portions, away from the immediate edge, as well as within lower points of the microtopography (Vaughn 1985:29). The characteristic surface features that develop serve to differentiate polishes with various worked materials. It is relatively quick to form on fine-grained flints when used to work harder contact materials, but slower with softer worked materials (Vaughn 1985:29).

As previously noted, different contact materials will produce distinctive use-related polishes. Through experimentation and observation, it is possible to classify polish types according to the worked materials. If the polish observed on tools was identified as being developed, I attempted next to identify the contact material. Below, I provide descriptions of the diagnostic characteristics of several polish types, including those associated with the working of animal hide, bone, and antler, as well as shell and wood. I also describe polish types associated with softer contact materials, including fresh meat and various plant materials. These descriptions are based primarily on observations made by Keeley (1980) and Vaughn (1985), but include those by other analysts and observations of experimental tools produced by Boyce Driskell at the Archaeological Research Laboratory, at the University of Tennessee. Descriptions of the polish produced during the cane processing experiments will be discussed later in this chapter.

- **Tanned or Dry Hide Polish**: The scraping of tanned or dried hide and leather produces a dull, heavily pitted, and wrinkle-like polish that may have a frosted glassy appearance (Logan 2014; Vaughn 1985). Given the elastic nature of the raw material, polish is widespread and continuous along the working edge and surrounding area. Working soft materials like hide, causes extensive edge rounding of the contact surface and all microfracture ridges in the immediate area of the active edge. If grit or foreign particles are introduced during the scraping process, it intensifies the edge rounding and pitting aspect of the polish (Vaughn 1985:37). The incorporation of grit also leads to the formation of numerous perpendicular and diagonal striations within the polish, which can be used to infer the direction in which the tool was used.
- **Bone Polish**: Experimental polish produced as the result of working fresh and soaked bone is very bright, with a surface texture that has been described as rough and rather pitted with a greasy-like appearance (Vaughn 1985:31). The texture of bone polish often resembles the spongy interior matrix of bones, making it easier to identify. Bone polish tends to form on the higher parts of the microtopography on the immediate edge of the contact surface, including on elevations, edge crests,

and scar ridges. However, polish also appears in isolated patches along the edge, rather than in continuous or linked components. Polish produced as the result of working bone rarely forms away from the working edge on noncontact surfaces, because of the hardness and density of bone. When used in a longitudinal motion (i.e., sawing, grooving bone), deep striations, troughs, or grooves may be visible running through patches of polish which often forms on both the dorsal and ventral surface of a tool. Extensive or prolonged scraping of bone will often result in the formation of intensive patches of bright polish with distinctly flat surfaces that are heavily linked (Vaughn 1985:31). This polish will be bright and highly reflective, but will retain a greasy luster. However, any type of extensive or prolonged contact with a hard material like bone, may result in the removal of microflakes along the working edge, essentially removing traces of use-related polish.

- **<u>Antler Polish</u>:** Experiments conducted by Keeley (1980) and Vaughn (1985) find that the characteristics of antler polish also differ according to the manner in which the antler is worked. Similarly to bone, sawing soaked antler produces what is referred to as "rough antler polish"; it is smooth, heavily linked, with diffuse depressions and pits that form along the immediate contact edge (Vaughn 1985:32). Polish produced as the result of sawing antler is quite similar in appearance to bone-sawing polish, and may only be differentiated if the polish is well linked. Transverse actions (i.e., scraping, planning, or grooving) result in the formation of "smooth antler polish". When well developed, smooth antler polish is very bright, and occurs in heavily linked, localized patches. The characteristic smooth surface contains diffuse depressions which “impart a gently undulating look” (Vaughn 1985:33). This surface feature has also been described by Keeley (1980) as having the appearance of a “melting snowbank” (1980:56). Vaughn (1985) notes that smooth antler polish is found in small localized patches on the working edge, as well as on the noncontact surface of edges. In many instances perpendicular troughs may be present within the smooth polish, indicating directionality. Typically, interpretations of this polish tend to be more general, referring to polish as “bone or antler”, rather than one or the other, as again it may not be possible to accurately distinguish between bone, antler, and ivory polishes.

- **Wood Polish:** Wood polish, in general, is one of the slower forming types of polish that progresses from generic weak polish, to an extremely bright polish with a smooth texture and domed appearance. With prolonged use, wood polish develops more fully, with isolated domed patches, often described as “bulging and sagging”, growing in both size and volume to eventually link up (Vaughn 1985:33). Over time, polish can become extensive and widespread, extending along the entire edge area and into interior portions of the tool away from the active edge. Vaughn (1985) reports that polish in various stages of develop can be observed on the same wood-working edge, particularly when the wood is worked in a transverse motion. Experiments have shown that both hard and soft woods create polish that, while identical in appearance, develop at slightly different rates. Contact with softwoods, for example, usually results in the quicker formation of polish due to increases in surface area in comparison to hardwoods (Logan 2014:157).

- **<u>Shell Polish</u>:** Experiments with shells and lithic tools are much less common when compared to other types of contact materials. Several studies have, however, attempted to describe polish that results from the working of both marine and freshwater shells, particularly in the production of shell beads. Yerkes (1983) describes shell polish as very bright, but not smooth in texture. The polish is described as flat, however it exhibits extensive cracking or crazing on the surface microtopograpy. Yerkes compares the polish appearance to "egg whites spread out on a broken mirror" (1983:504). Additional experiments with shell by Pearson and Cook (2012), found that the polish was bright and almost silvery, and that it tended to be confined to the highest points on a tools microtopography, or the tips of the experimental drills. Other usewear experiments with shell are those which use the shell as tools in an effort to test tool efficiency and also describe polish formation on the shell itself (Szabo 2008; Tumung et al. 2015; Weston et al. 2017).
- **<u>Fresh Hide and Meat Polish</u>:** Fresh hide polish forms as hair or fur, skin, fat and other tissues are removed during the various processes associated with skinning and de-fleshing (Logan 2014:296). Regardless of the animal involved, the polish is fairly slow forming and is relatively dull and rough, with no rounding. While only marginally brighter than the surrounding surface, this polish is well-linked, and depending upon duration of use, may be extensive. Some analysts have also reported a slightly greasy luster-like appearance with tools associated with fresh hide and meat (Logan 2014). It tends to occur in small irregular patches very close to the working edge, but with prolonged use the crest of the working edge

may develop a bright, thin, smooth band of polish that follows the edge margin (Vaughn 1985:38). Implements used in a transverse motion, such as scraping, may only develop polish on the working edge, and although rare, perpendicular striations may form. When slicing or shaving actions are performed (i.e., longitudinal motion) during the defleshing of hides or cutting of meat, polish will be distributed on both the ventral and dorsal surface of a tool's edge. In general, it is characterized as dull, generic weak polish that may be difficult to distinguish (Vaughn 1985:38).

- **Butchering Polish:** Polish produced during the butchering of a carcass is dependent upon the "relative amounts of bone vs. meat and skin contact", and is generally not very extensive (Vaughn 1985:38). Contact with bones have the tendency to cause excessive microfractures along portions of the working edge, resulting in the elimination of polish in these areas. Experiments conducted on a variety of animal carcasses, resulted in the formation of a smooth thin band of polish on the crest of the working edge. This may range from weak generic polish within parts of the immediate working edge to small patches of smooth-pitted polish associated with contact with bone (Vaughn 1985:38).
- **Plant Polish:** Plant polish tends to form slowly compared to the types of polish previously discussed, however the stages of development are similar, with use-time and intensity affecting formation. Plant polish generally begins in the generic weak stage, from which it develops into patches of bright, smooth-pitted polish. Continued use causes the polish to expand and become increasingly linked together, however at this stage it still contains varying amounts of pits,

> depressions, and interstitial spaces (Vaughn 1985:36). Plant polish that is well-developed is almost completely linked, forming a "solid, flat, smooth polish blanket" whose topography is considerably raised above the natural stone surface (Vaughn 1985:36). It is extremely bright and highly reflective, and is often associated with "sickle gloss". Despite the overall smooth topography, well developed plant polish will retain a pockmarked appearance with "comet-shaped pits". It may also contain striations which look superimposed upon the polish surface, with a filled-in or partially eroded appearance (Vaugh 1985:36).

Experiments have demonstrated that differences can be observed in the formation and appearance of plant polish depending upon the relative amount of silica content. Siliceous, or fibrous-rich plants, tend to produce polish that is extremely smooth and bright with a glass-like appearance. At any stage of development, silica-rich plant polish tends to be widely distributed and continuous along a tool's edge, extending into the interior away from the active edge. The working of plants with less silica produce a less reflective polish that is poorly linked and not well developed.

In addition to use-related polish, polish has the potential to form as the result of prehension and hafting. During use, grit and dirt present on fingers may lead to the development of generic weak or smooth-pitted polish in areas where the tool was gripped (Vaughn 1985:39). Rots (2005) notes that it is not the flesh of the hand that determines the polish, but the particles of contact materials that detached when the tool is being used. During use, detached particles and grit may adhere to the hand, and friction between these particles and the tool results in the formation of polish (2005:65). The more particles introduced during use, the greater potential there is for the development of prehension polish.

- **<u>Hafting and Prehension</u>**: Polish may also develop on areas of a tool where a haft or binding materials were present, and it will differ according to the various haft materials utilized. Hafts produced from wood, antler, and bone will generally produce distinctive polish during use when the haft rubs against the edges, ridges, and surfaces of the tool itself (Vaughn 1985:40). Binding materials, including leather, sinew, and vegetal material, also leave different, well-localized patches of polish when wrapped around flint tools. Both hafting and binding polish tend to be localized, developing on parts of the tool in direct contact with the haft and wrappings, rather than being restricted to the active tool edge (Rots 2005). Polish from both prehension and hafting may appear on the ventral and dorsal surfaces of a tool, as well as on the proximal ends.

6.2.1 Non-use Related Polish

Non-use related polish can form on tools as the result of several different processes. These include contact with percussors during manufacture and retouch, contact with soil after deposition, archaeological excavation, recovery, and handling post excavation. During manufacture and retouch, tool edges are repeatedly struck with hammerstones and percussors made of antler or bone. Surfaces and edges of tools in direct contact with hammerstones may develop a thin band of bright polish that is characterized as "bumpy" or uneven because it contains concentrations of well-formed, short, deep, wide grooves which are oriented perpendicularly or diagonally to the edge" (Vaughn 1985:41). The more an edge is struck with a hammerstone, the more developed this polish may become. Antler and bone percussors produce polish on the immediate edge area of the tool. Percussor polish tends to be a bright, smooth-pitted polish that is patchy and only partially linked (Vaughn 1985:41).

Post deposition polish may develop on stone tools as the result of contact with soil and the surrounding matrices. In the initial stages of development, soil polish or sheen, is characterized as generic weak, with few distinguishing characteristics. Extensive contact with soil produces a polish with a dull or matt appearance, with an overall rough and pitted texture. There are differences and variations in volume, pit depressions, micropits, and interstitial spaces within soil polish, as well as short grooves and troughs running through polish patches (Vaughn 1985:42). Soil sheen is not restricted to any one part of a tool, but may develop in patches on the entire surface of an artifact. This extensive coverage is one of the most important criteria for distinguishing soil polish from use-related types of polish (Vaughn 1985).

Archaeological excavations and the associated recovery techniques may also lead to the formation of polish-like patches. Metal excavation equipment, including backhoes, shovels and trowels, can leave bright and reflective patches on tools which mimic polish. These patches generally exhibit a much more metallic appearance, and may occur in random patches on any surface of the tool. The cleaning and handling of artifacts also produces reflective patches that can be mistaken for use-related polish. These reflective patches are generally the result of finger oils, and they can be distinguished from polish based on a distinctive iridescent sheen. Traces of finger oil can be remedied by properly cleaning artifacts prior to microwear analysis.

While there are several characteristics which help analysts differentiate between various types of polish and polish-like patches discussed, there is still a great degree of overlap between both use-related and non-use related polishes in their initial and developed forms. Interpretations are therefore dependent upon an analyst's familiarity with general patterns of polish development in an array of contact situations. With that being said, the factors affecting the formation of polish and microwear are numerous, and despite one's best effort, it may not be possible to identify specific contact materials responsible for producing the polish present on lithic artifacts. Polish alone, is often not enough to determine tool function. Interpretations regarding the function of lithic artifacts requires that analysts consider the types of variables involved in the formation of wear, and take into account all forms of use damage (i.e, microfractures, rounding, striations, and polish) present on the tool. By combining information obtained from macroscopic observations, as well as low and high-power analyses, analysts have a greater chance of inferring tool function.

6.3 Methodology and Data Collection

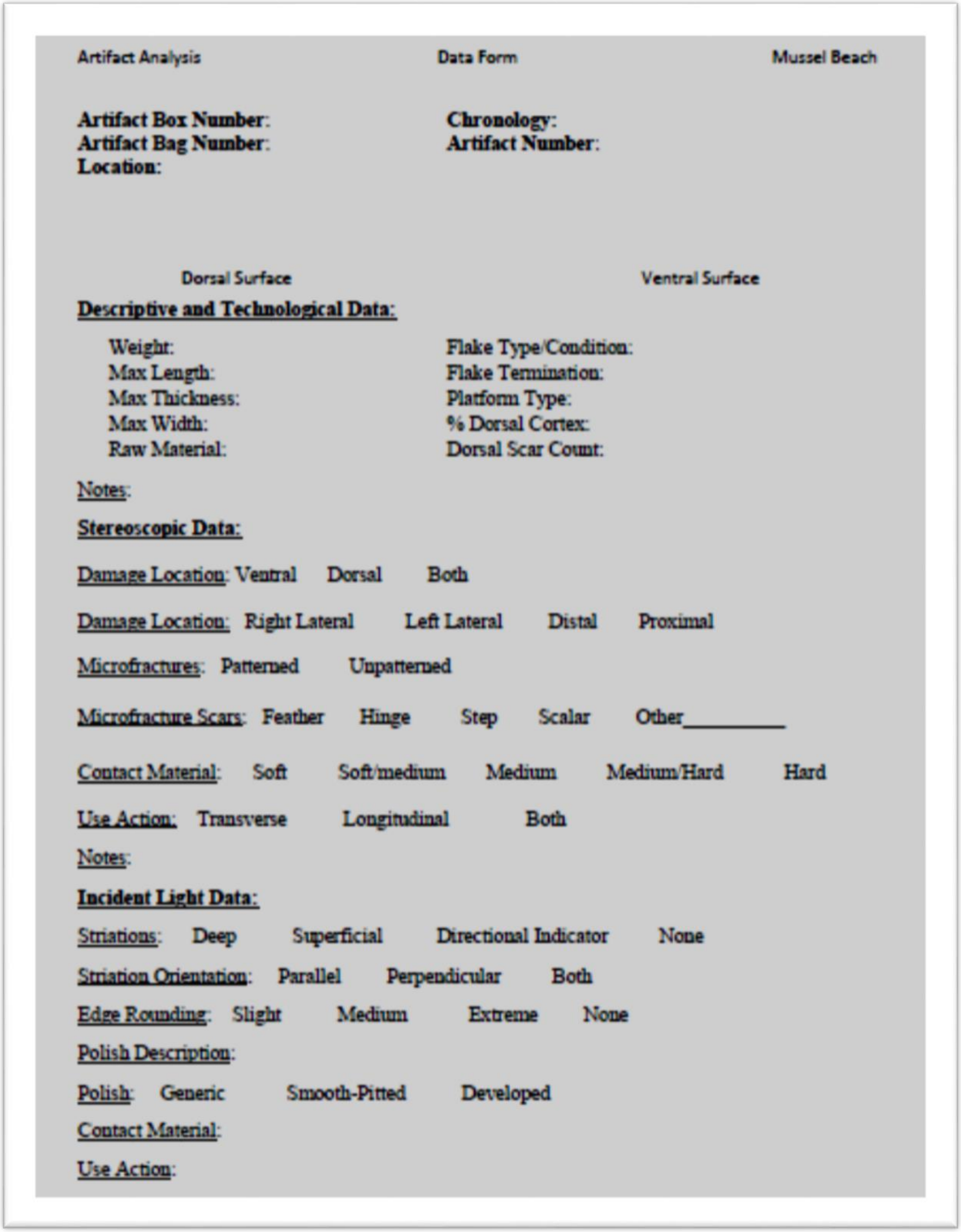
The functional analysis of many lithic artifacts from archaeological assemblages typically involves only a sample of the total tool assemblage. Selecting individual artifacts for microwear analysis depends on several factors, including, but not limited to, the condition of the artifacts and the size of the overall assemblage. In large lithic assemblages it is common to establish some sort of sampling criteria for artifact selection, as the process of analyzing artifacts under high-power is time consuming.

6.3.1 Analysis Protocol and Cleaning Procedures

In Chapter 5 I outlined the methodology and processes used to identify, classify, and stratify the flake tool assemblage from Mussel Beach. Chapter 5 also included information related to the low-power analyses and presented the preliminary interpretations for each flake tool category. In this section I briefly revisit the methods utilized in the selection of tools for usewear, as well as the protocol followed during this important stage of analysis.

Selecting tools for functional analysis was essentially a stepwise process. As previously mentioned, the initial analysis of the lithic assemblage by New South associates only identified 39 expedient flake tools, and it was hypothesized that the debitage assemblage contained many more utilized flakes. The first step in the stepwise process, as model by Driskell (1994, 1998), and outlined by Rigney (2009) and McMillan (2016), involved the examination of all artifacts at the macroscopic level. In this case 100% of the debitage (n=28,132), regardless of size, form, or context, was examined with the naked eye with aid of a 10x hand lens and illuminated 5x lens. Any specimen exhibiting secondary fracture scars, regardless of pattern or degree of edge damage, was identified as a probable flake tool and was selected for further analysis. The second step in the stepwise process was the examination of all 924 probable flake tools under low-power magnification. Prior to any analysis, however, the specimens were photographed and the data forms created. Each artifact form contained to-scale photographs of the artifacts, including a dorsal and ventral view, as well as spaces designated for data collection. Data collected on each specimen would eventually include metric data, morphological data, technological information, and observations from low and high power analysis (Figure 6.1).

The first stage of the microscopic analysis was accomplished using an Olympus SZ61 stereomicroscope with magnifications between 6 and 45x. The goals of this analysis were to identify areas of potential utilization and document patterns in microfractures and edge attrition. The analysis of each specimen (n=924) included the examination of each edge from a dorsal and ventral perspective. Location(s) of damage were noted on the image and characteristics of the damage were recorded in detail (see Chapter 5). Under low-power magnification areas with use-related damage were identified and microfractures were characterized based on their type, orientation, and distribution. If possible, hypotheses regarding use motion and hardness of contact material were made. Specimens with damage that appeared random and non-patterned, or those believed to be the result of non-cultural or post-depositional processes, were eliminated from the sample *and* were not subjected to further analysis. Also eliminated were artifacts



Artifact Analysis Data Form Mussel Beach

Artifact Box Number:
Artifact Bag Number:
Location:

Chronology:
Artifact Number:

Dorsal Surface Ventral Surface

Descriptive and Technological Data:

Weight:
Max Length:
Max Thickness:
Max Width:
Raw Material:

Flake Type/Condition:
Flake Termination:
Platform Type:
% Dorsal Cortex:
Dorsal Scar Count:

Notes:

Stereoscopic Data:

Damage Location: Ventral Dorsal Both

Damage Location: Right Lateral Left Lateral Distal Proximal

Microfractures: Patterned Unpatterned

Microfracture Scars: Feather Hinge Step Scalar Other__________

Contact Material: Soft Soft/medium Medium Medium/Hard Hard

Use Action: Transverse Longitudinal Both

Notes:

Incident Light Data:

Striations: Deep Superficial Directional Indicator None

Striation Orientation: Parallel Perpendicular Both

Edge Rounding: Slight Medium Extreme None

Polish Description:

Polish: Generic Smooth-Pitted Developed

Contact Material:

Use Action:

Figure 6.1: Datasheet for Macroscopic and Microscopic Observations on Flake Tools

lacking provenience information. The remaining sample of tools was small, consisting of only 308 specimens, just 1% of the total debitage assemblage. These flake tools were placed into tool categories based on their degree of edge damage. Before artifacts were examined under high-power magnification they had to be thoroughly cleaned of any finger grease, dirt, or extraneous particles.

Cleaning Procedures:

Standardized cleaning procedures for stone tools prior to microscopic examination differ between analysts. The way in which an artifact is processed and prepared for analysis can potentially influence microwear patterns and overall interpretations of tool use. Archaeological and experimental specimens may not only retain remnants of dirt and organic matter, but also finger oils and residues from handling. Keely (1980:10-12) advocates for all specimens to be cleaned using chemical solvents prior to examination. It is suggested that tools first be wiped with white or methylated spirits to first remove finger grease, and then washed in a solution of hot water and a mild detergent free of abrasives. After these initial steps, Keeley (1980:11) suggests that tools be immersed in a warm HCl and NaOH solution in order to remove any extraneous calcitic and organic deposits. Keeley (1980:11) notes, however, that leaving tools immersed in this solution for too long can cause a light, white patination on the tool. If specimens are still embedded with particles of sand, silt, or clay, Keeley (1980:11) suggests they be immersed in an ultrasonic cleaning tank or a prolonged immersion in hot HCl.

The use of chemicals in the cleaning of archaeological specimens has received some criticism because of the potentially harmful effects that the chemicals can have on the specimens. An alternative cleaning procedure, suggested by Grace (1989) and Levi-Sala (1996:18), advocates for the use of biological cleaning agents rather than chemical. Experiments with biological solutions by Levi-Sala (1996:18) found that they are not only harmless to specimens, but that they are just as effective for removing extraneous organic matter from tool surfaces. Kay (1998; 746) also advises against the use of harsh chemicals on stone tools. Kay (1998:746) suggests using more mild solutions to clean stone tools, such as simply wiping specimens with methyl alcohol.

Having considered each cleaning procedure carefully, it was decided that the exposure of Mussel Beach and experimental specimens to harmful chemicals would be limited. All specimens being processed for usewear analysis were handled with latex-free gloves during and after cleaning. The cleaning procedure was the same for the experimental and archaeological specimens selected for usewear analysis. All specimens were submerged in a warm solution of water, a mild biological household detergent, and diluted ammonia. Specimens were left submerged for 10 minutes before being gently scrubbed with a soft bristled toothbrush and then thoroughly rinsed under warm water. Before being laid out to dry, specimens were wiped down with a cotton ball soaked in alcohol. The alcohol safely removes stubborn finger grease and residual chemicals, and also facilitates faster drying. Before being placed into individual specimen bags, the stone tools were examined for any organic material still adhering to the surface or embedded within ridges or flake scars. Specimens not fully cleaned during the initial cleaning phase were subject to an additional round of cleaning involving the same procedure. Both during and after usewear analysis, specimens were wiped down with alcohol to remove any finger grease. Because the incident light microscope requires all specimens to be mounted to slides with modeling clay, many specimens end up with small amounts of clay adhering to the surface. To avoid this, the surface clay is always covered with a layer of paper towels. In the event that specimens were exposed to clay, they were fully rewashed before being analyzed further or curated.

6.3.2 High-power Data Collection

The high-power analysis was accomplished using a Zeis Axio compound microscope with 100w halogen incident lighting and Epiplan brightfield/darkfield objectives. This microscope is equipped with magnifications between 50x and 500x, which are used to record and describe striations, edge rounding, and micropolish. The first step in this portion of the analysis was to scan the ventral surface of the artifact under 50x and 100x magnifications. This preliminary surficial scan is an important step in the analysis because it provides an opportunity to examine the raw material to look for natural bright inclusions or features which might be mistaken for use-related polish. After the scan is complete, the artifact is mounted onto a glass slide using modeling clay. In an effort to avoid clay adhering to the surface of the artifact, clean paper towels were always placed in between the clay and artifact. The artifact is positioned onto the clay at an 85 to 90 degree angle so that tool edges can be examined edge-on. The primary goals of the high-power analysis were to identify polish, striations, and edge rounding and then to characterize and describe each in an effort to identify contact materials and use actions. All microscopic observations were recorded on the individual data forms and the first areas to be examined are those previously identified during the low-power analysis.

Once the artifact was mounted the edges were examined under each level of magnification, beginning with 50x magnification and continuing to 500x on potentially utilized areas. Table (6.1) provides a summary of the various variables/types of usewear that were recorded during the analysis. At 50x it is possible to observe edge rounding and deep striations. Polish, if present, will appear as bright spots on the tool surface, but under this level of magnification it is not possible to observe polish morphology. The location of these “variables” are again noted on the data form to ensure that I would be able to locate specific patches of wear in the future. Artifacts found to have polish and/or striations were then examined under 200x,

Table 6.1: Summary of Data Collected During High-power Analysis

1. Bag Number	**10. Polish Stage**
2. Artifact Accession Number	a. Generic
3. Tool Type	b. Smooth-pitted
4. Edge Damage	c. Developed
a. Patterned/Non-retouched	**11. Polish Description**
b. Retouched	a. Plant (general)
c. Non-patterned	b. Wood
5. Edge Damage Location	c. Bone/Antler
a. Singular Lateral Margin	d. Hide (general)
b. Multiple Lateral Margins	e. Fresh Meat/Hide
c. Distal End	f. Indeterminate
d. All Margins	g. Non-cultural
6. Edge Damage Distribution	**14. Use Action**
a. Ventral Surface	a. Cutting (longitudinal)
b. Dorsal Surface	b. Transverse (scraping)
c. Ventral/Dorsal	c. Boring/Drilling
7. Striation Attributes	d. Graving
a. Deep Striations	e. Haft Damage
b. Superficial Striations/Streaks	f. Non-cultural
c. Directional Indicator	
8. Edge Rounding	
a. Yes	
b. No	
c. Extreme	
9. Polish Location	
a. Ventral Surface	
b. Dorsal Surface	
c. Ventral/Dorsal	

which allowed me to describe and characterize polish and/or striations in greater detail. In addition to characterizing polish based on stages of formation, these additional polish characteristics are noted: location and invasiveness along the tool's edge, brightness, surface texture, degree of pitting, and degree of linkage. In most cases polish can be identified and described well under 200x magnification, however, 500x magnification does provide greater detail of polish texture and microtopography, allowing me to make hypotheses regarding specific contact materials.

6.4 Experimentation and Usewear Analysis

As previously mentioned, the interpretation of microwear on lithic artifacts often relies on the development and analysis of experimental tool collections. Experimentation with stone tools has allowed many analysts to document use-related damage and other diagnostic surface features that develop during use. While a comprehensive collection of experimentally produced tools were available for comparative purposes at the Archaeological Research Laboratory, many tools in the assemblage did not exhibit diagnostic polish, several were manufactured on tool stone not available at the Mussel Beach Site, and the collection did not include tools used for cane processing. In order to ensure that usewear interpretations were accurate it was necessary to conduct a series of experiments and develop an experimental program designed around the processing of cane for basketry purposes.

With regards to the types of usewear experiments conducted, Stone (2011:142) notes that there are two primary approaches to designing and organizing experiments for comparative purposes. The first approach, referred to broadly as "task-based", is designed to provide information on patterns of wear that develop during specific tasks or activities. These types of experiments not only allow the analyst to assess tool efficiency, but they often provide an opportunity to observe tool use directly and document more specifically how the tool is used. Analysts using a task-based approach may pay specific attention to how a tool is held or positioned during use, changes or adjustments in tool movements, the amount of pressure applied, and the speed with which the tool is used and the task is completed (Stone 2011:142). When applying a task-based approach, it is essential that the individual(s) performing the tasks have experience with not only the tools, but also the materials being worked so that the wear that develops is an accurate representation of tool use. The development of usewear may differ depending upon the skill level of the individuals and their ability to perform the task efficiently. The wear patterns that develop as a result of task-based experiments are believed to be similar to those found on archaeological specimens used in comparable circumstances. Stone (2011:143) notes that archaeologists rarely become proficient in the production and use of prehistoric tools, and thus an additional component of this experimental approach is often ethnographic in nature.

In contrast to task-based experiments are those Stone refers to as "action-based", which are designed to isolate only a particular aspect of a task at the surface or object level (2011:143). The goal of action-based experiments are to document wear that develops as the result of "one particular type of contact between two materials" (Stone 2011:143). During these types of experiments, tools are generally used only in a single motion, and the pressure, angle, and speed with which a tool is used are held constant for the entire duration of the experiment. The individuals performing the experiments are not attempting to replicate an entire task, but seek to document usewear that develops under specific use conditions. When all of the variables are controlled, it is possible to connect specific wear patterns or features to explicit gestures or contact materials. Generally, action-based experiments do not require one to be particularly skilled or experienced to perform the task, however the wear that develops may not always be similar to those present on archaeological specimens.

A third type of experimental program outlined by Stone (2011) is one referred to as "direct-confirmation experimentation". Stone describes these experiments as those in which a hypothesized use for a tool is replicated and the wear patterns that result are compared to archaeological specimens in an effort to assess a hypothesis (Stone 2011:146; Owen 1994). Stone cautions against the use of these types of experiments, as they can often be influenced by ethnocentric, androcentric, and historical biases (Stone 2011: 146). Such experiments can be useful, however, when considering tasks or contact materials that have few ethnographic or historical correlates, as they may provide new insight into tool use effectively filling gaps in our knowledge regarding certain prehistoric behaviors.

6.4.1 Experimental Program

Most of the experimental tools created for this dissertation research followed the programs designed by Keeley (1980) and Vaughn (1985) and include both action-based and task-oriented approaches. For this dissertation, the flake blanks utilized as experimental tools were derived from Bangor, blue-gray Fort Payne, Knox Black, St. Louis, and Kentucky Hornstone cherts. Because flake technology was of primary interest in this dissertation, only flake tools were utilized in the experimental program. Having experience and practice in flintknapping, I was able to produce all of the flake blanks for this study from chert cores using traditional hard and soft hammer percussion techniques. The working edges of the flake blanks were not retouched or modified prior to use, however, some flake margins were slightly retouched in order to be hafted into simple wooden handles. Because a large and comprehensive collection of action-based experimentally used tools was available for study at the Archaeological Research Laboratory (ARL), only a small component of the experimental program was considered to be action-based. This portion is action-based because I deliberately used individual flake tools on specific contact materials in a restricted number of motions. Flake tools were used, for example, to cut, saw, and scrape dry bone and antler, wood, shell and dry hide. Descriptions of tool use, included type and condition of contact materials, duration of use, and tool motion. These experiments were conducted in order to gain familiarity with the contact materials and the wear patterns that develop from use. Tools used experimentally were treated the same way as the archaeological specimens, in that they were photographed and the wear patterns were described for both low and high-power microscopy. Because usewear associated with hide, wood, bone, and antler have been well documented by other usewear analysts (Keely 1980; Vaughn 1985), the results of these action-based experiments are not reported in this dissertation. However, all of the experimentally produced tools were extensively studied and referenced throughout the analysis of the archaeological sample.

A much larger component of this project involved a task-oriented experimental approach. The primary task involved was the processing of river cane into pliable weaving splits with flake tools. The goals of the experiments were twofold- first to investigate the efficiency of flake tools in the processing of river cane, and secondly to characterize the macro and microscopic wear patterns that developed during specific stages of use. As mentioned in Chapter 3, there is very limited information available for cane processing activities prior to the arrival of Europeans in the Southeast. Much of what has been written about split-cane technology is ethnographic in nature, but involves the use of modern technology in processing activities. While there are references to the use of lithic tools in the processing of river cane, it has not been observed or documented in ethnographic or historical contexts. As previously noted, cane processing is considered to be extremely difficult and demanding, and often requires years of practicing before weavers are considered to be highly skilled. While I did attempt to process cane for a series of preliminary experiments, it was obvious that my lack of knowledge and skill level was problematic. As a result, I contacted Roger and Shawna Cain, expert basket makers and National Treasures from the United Keetoowah Band of Cherokee Indians (UKB) in Oklahoma. Of the pair, Roger is often responsible for the harvesting and initial processing of the culms, while Shawna performs the final thinning and weaving of the prepared splits. Their knowledge of rivercane and skill level as weavers is unparalleled. While neither had experience processing cane with stone tools, they were given the opportunity to familiarize themselves with the technology and practice prior to our experiments. When working with Roger and Shawna, I also had the opportunity to learn the correct ways to harvest and process cane, which enabled me to perform additional, more action-based experiments on my own. To my knowledge, this dissertation represents the first time that stone tools were experimentally used to process river cane and the first time that the result of such activities are documented for comparative purposes.

6.4.2 Results of the Cane Processing Experiments

In total, 15 flake tools were used in varying degrees to experimentally process river cane. With such a small sample size, it is recognized that the wear patterns associated with these tasks may not encompass the full range of wear possible, and therefore the results are still considered to be preliminary. Of the 15 flake tools used, only a portion were utilized enough to develop use-related wear. Many of the flakes were tested for particular tasks and quickly discarded because they proved to be inefficient for various reasons. The three specific tasks for which wear was documented on flake tools include the splitting and quartering, peeling, and scraping of cane culms. In some cases, a single tool was used to complete all three tasks, while in other instances multiple tools were used interchangeably. In order to replicate realistic use-contexts

Roger and Shawna were not asked to use different tools to complete individual tasks, unless they felt the need to do so. As such, the wear patterns that developed on the experimental tools are believed to be representative of some cane processing activities, and can therefore be used cautiously for comparative purposes. The experimental tools were given unique identifiers beginning with Exp-01 and continuing to Exp-15. Below I provide detailed results of the wear patterns from a few of the experimental specimens.

Exp-01 and Exp-05

Tools Exp-01 and Exp-05 were both used to peel away the inner fibers from the hard outer culm. Tool Exp-05 was also experimentally used to scrape, however it was found to be more effective as a peeling tool. This process, as described in Chapter 4, requires that the sharp edge of the flake be positioned between the fibrous materials and hard cuticle (Figure 6.2). The weavers must continuously twist their wrist and hand to manipulate the tool as it moves down the length of the culm, separating the fibers from the cuticle as it goes. Difficulty can often arise at the culm nodes, and weavers must know how to work both the tool and culm in order to remove the inner peel in one piece. During this process, the sharp edge of the flake is only in direct contact with the cane culm when the fibers are initially separated from the cuticle. Under low-power magnification, the two peeling tools used exhibited very similar forms of microwear (Figures 6.3 and 6.4). Each tool displayed medium to large patterned half-moon and scalar fracture scars that were slightly rounded. The damage along the working edges was not extensive, but did span the length of the edge. Under high-power magnification bright polish was observed in non-linked patches slightly away from the working edge of both tools. This polish ranges from generic to intermediately developed in some patches, and is best described as smooth-pitted. There are, however, small isolated patches of well-developed polish that look

Figure 6.2: Shawna Morton Cain and Roger Cain Peeling Cane Splints with a Flake Tool

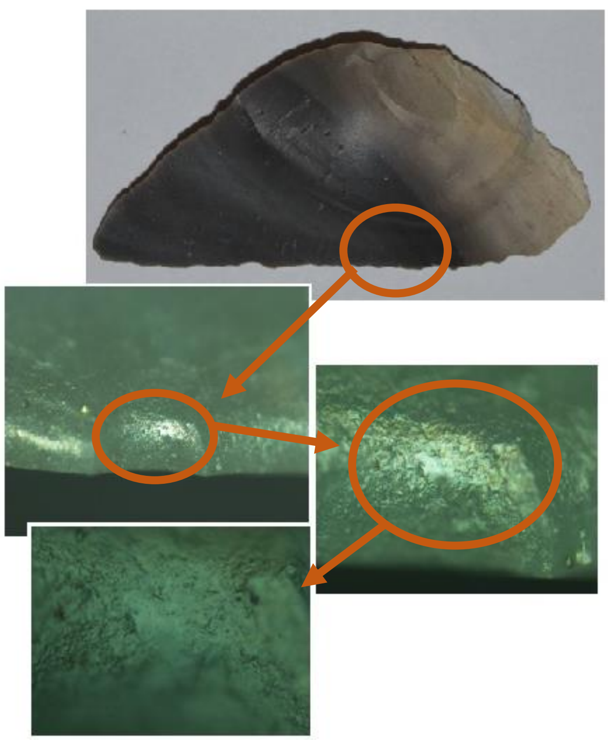


Figure 6.3: Flake Tool Used to Peel Cane Culms (Exp-01)

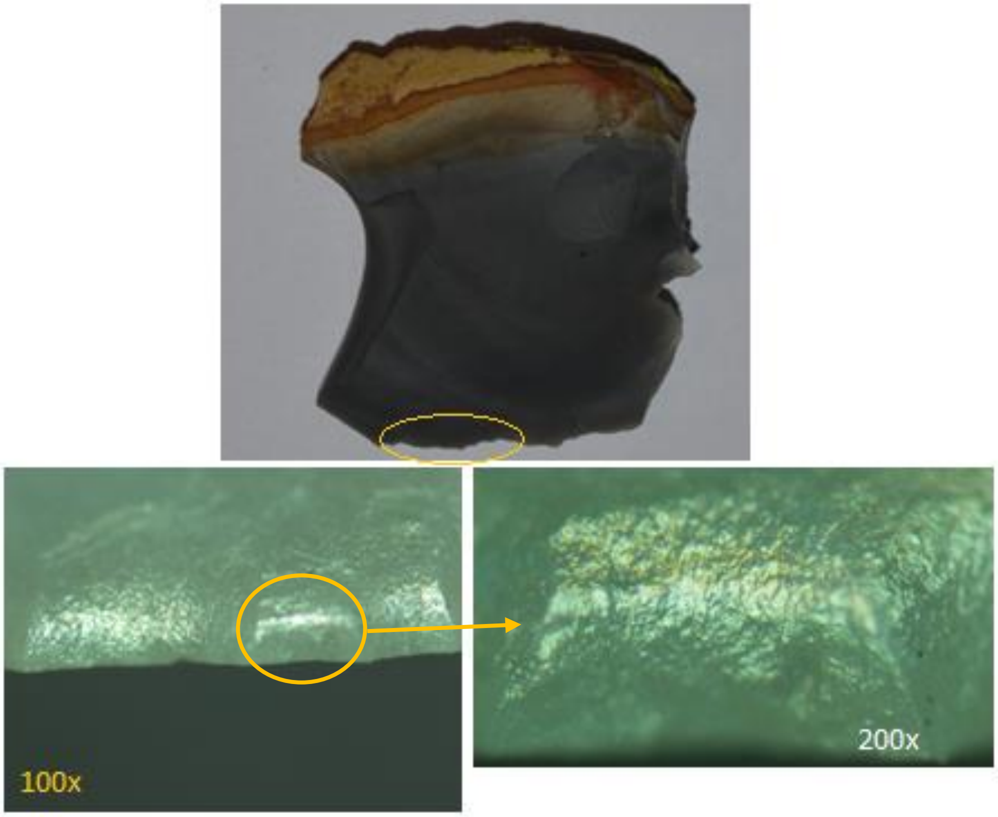


Figure 6.4: Experimental Flake Tool Used to Peel River Cane (Exp-05)

similar to early and intermediate stage wood polish. Striations, superficial streaks, or directional indicators are not visible on either experimental tool.

<u>Exp-015</u>

Tool Exp-015 (Figure 6.5) was not only used to split and quarter 15 culms, but was also used to peel the 120 resulting splits. This particular flake tool was relatively large with steep edge angles, measuring between 70 and almost 90 degree. Macroscopically, this large flake exhibited almost no visible edge damage, and even under low-power magnification there was still very little in the way of patterned edge damage. Small flake removals were observed in isolated patches along the working edge, but I would describe these as non-patterned edge

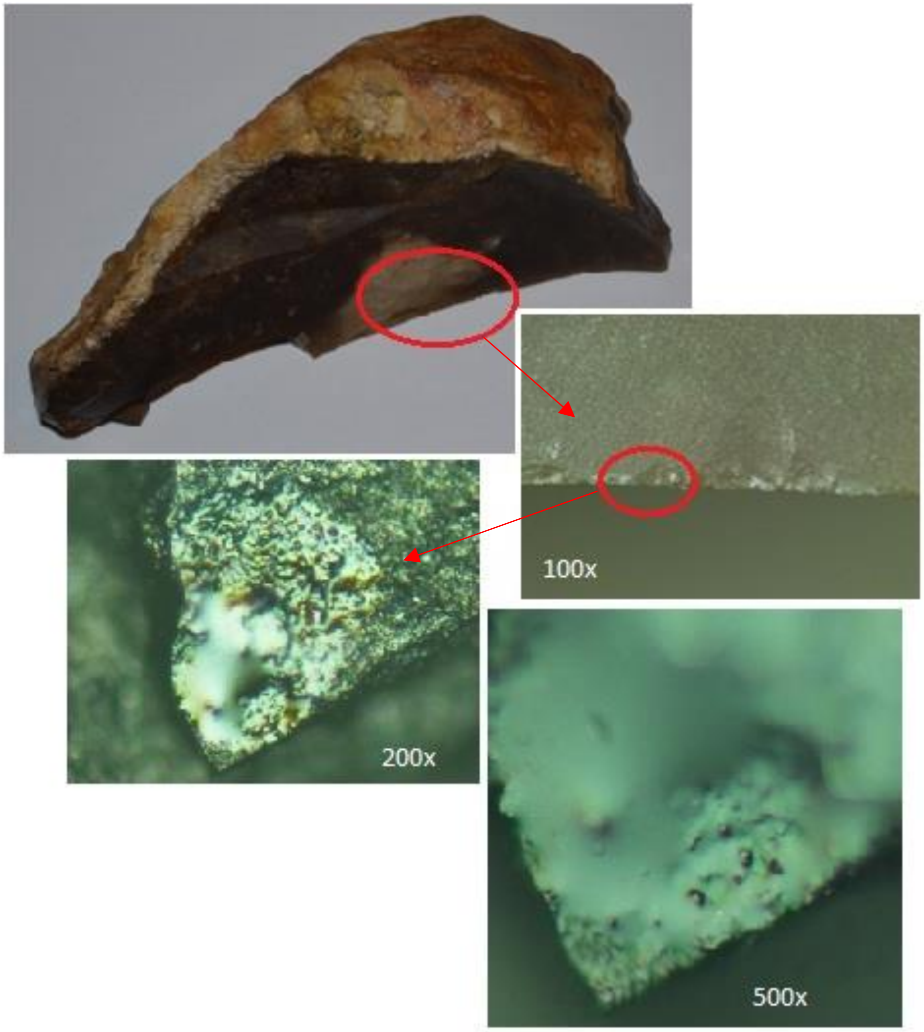


Figure 6.5: Flake Tool Used to Split and Peel Cane Culms (Exp-15)

nibbling. There are also medium to large isolated hinge terminations in some microfractures and areas of edge crushing. Based on the distribution of these microfractures, the edge damage may not have been characterized as cultural if this had been an archaeological specimen. Under high power magnification, very little to almost no edge rounding was observed and there were no striations or visible linear features. Polish, however, was observed along the entire crest of the working edge, but it was not well linked or evenly distributed. This band of polish is not well developed and can only be described as generic. In addition to this band of polish along the crest, there were isolated patches of polish located close to the working edge on higher portions of the tool's surface. These isolated patches are extremely bright, highly rounded, and appear mounded or raised above the stone surface. The developed portions of this polish are extremely smooth, containing only a few of the pits or depressions which often characterize plant polish.

EXP-02, EXP-03, EXP-04, and EXP-05

Flake Tools EXP-02 to EXP 05 were all used exclusively to scrape away the inner fibers from the culm cuticle. These four tools were similar in size, but the edge angle ranged between 20 and 50 degrees. The wear patterns observed under low-power magnification on these four experimental flake tools were remarkably different despite having been used to accomplish the exact same task for the same amount of time. Tool EXP-02 (Figure 6.6), for example, exhibited medium to large half-moon fracture scars with isolated non-patterned scalar scars, giving the edge a denticulated or seriated appearance. Tool EXP-03 (Figure 6.7), in contrast, exhibited continuous damage along the entire working edge that can only be described as edge nibbling. Tool EXP-04 (Figure 6.8) was characterized by irregular, non-patterned edge damage, consisting of a scalar, hinge, and step fractures. While tool EXP-05 (Figure 6.9) did exhibit some denticular patterning, the working edge was dominated by patterned scalar scars. Under high-power magnification, the polish recorded on all four of experimental tools differed in development, distribution, and intensity. The polish on tool EXP-02, formed in localized patches on the highest points of the edge's microtopography. At this early stage of development, the polish is extremely bright and reflective, containing varying amounts of pits and depressions. It is described as generic at best. This is in direct contrast with tool EXP-03, where well-developed polish was observed in a continuous bright ribbon directly along the entire crest of the working edge. It is completely linked and appears slightly raised above the natural stone surface, similar

Figure 6.6: Usewear on Flake Tool from Peeling Cane (EXP-02)

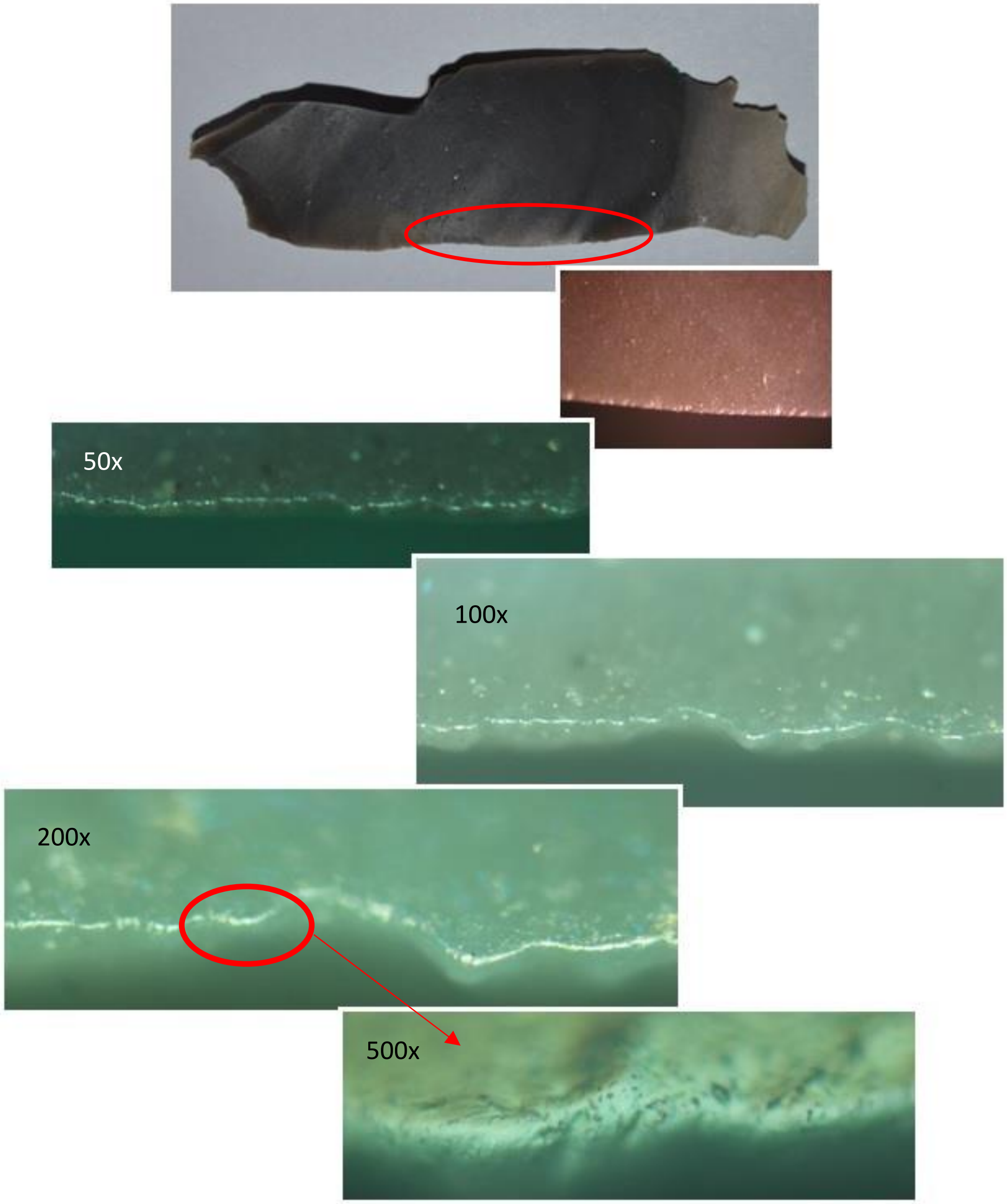


Figure 6.7: Usewear from Scraping Cane Splint (EXP-03)

Figure 6.8: Usewear from Scraping Cane (EXP-04)

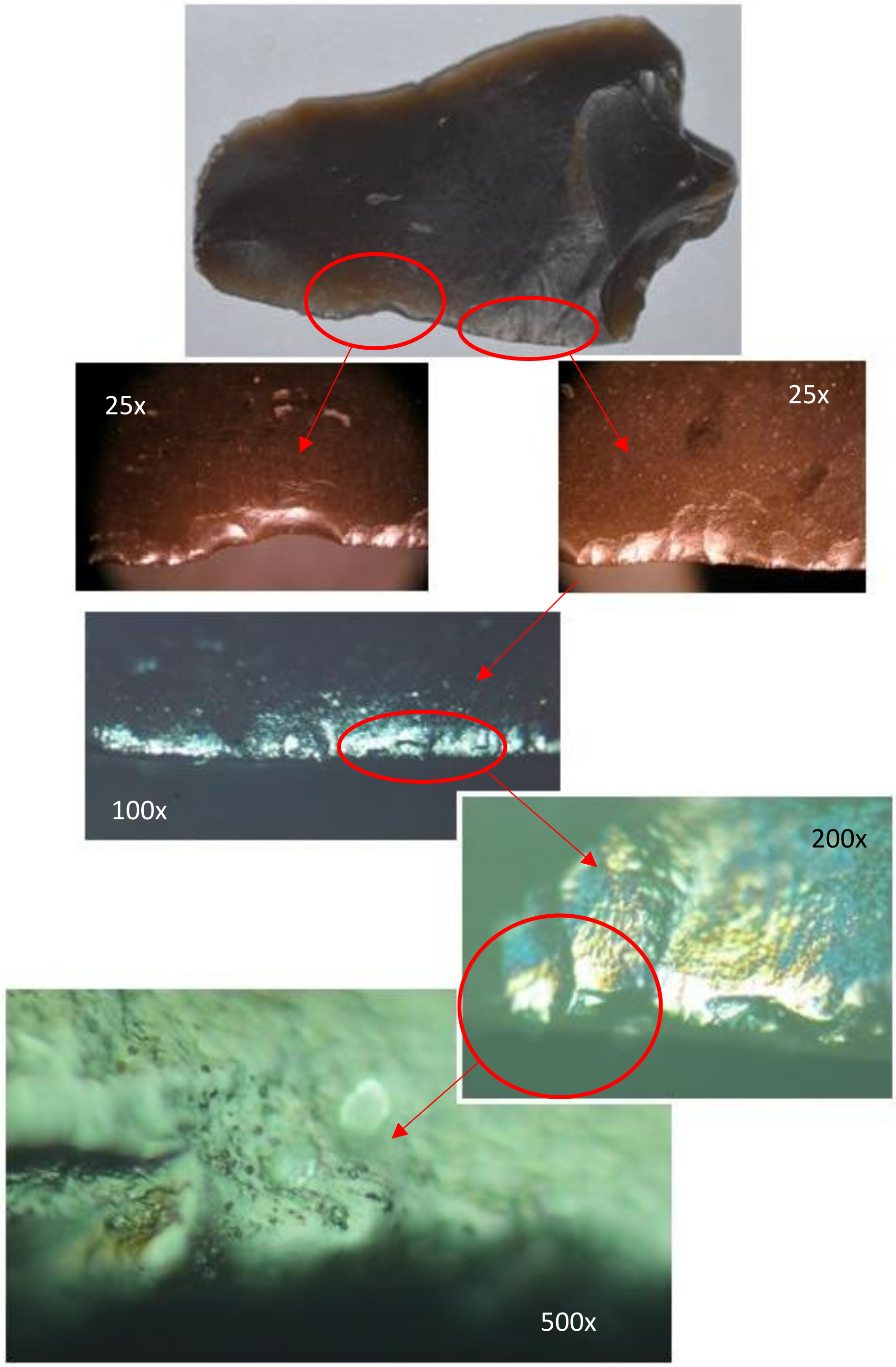


Figure 6.9: Usewear from Scraping Cane (EXP-05)

to wood polish. The polish that developed on tool EXP-04, occurs in isolated patches, and ranges from weak generic to more of an intermediate stage of development, often referred to as smooth-pitted. Like weak generic polish, smooth-pitted polish cannot be definitively linked to material worked. Lastly, the polish on tool EXP-05 formed in a series of small linear patches along the crest of the active edge. It is well developed, and is characterized as relatively smooth and highly rounded, appearing more similar to hide polish than plant polish.

Based on the experiments conducted, it is evident that certain cane processing activities do leave signatures on stone tools, and moreover there are observable differences in the development of wear on implements used to peel cane and those used specifically to scrape. Polish that developed on tools used to peel for example, tended to form away from the working edge on the crest of the flake scar closest to the termination. These areas exhibited some degree of edge rounding as well. Polish observed on tools used to scrape, in contrast, was concentrated directly on the working edge along the entire crest and within fracture scars and scar margins. The differences in microfractures, edge rounding, and polish development observed on the scraping tools is likely the result of differences in raw material, the angle of the working edge, and moisture content in the cane. While it is not well understood to what extent moisture content affects polish formation, it was clear the dryer the culms became the more resistant they became during the scraping process. It is easy to see why weavers prefer to soak splits and keep them hydrated before scraping.

6.3.3 Future Experimental Work

In terms of identifying cane processing on lithic artifacts, I feel that the results presented in this dissertation were promising, but they do underscore the need for additional experimental work. Future experiments should consider additional tool types in the processing of cane, including bifacial tools, blades, and shells, as they have been referenced ethnographically. As previously noted, it is unclear how the moisture content in the cane affects the formation of polish, and it is also unclear if the age of the cane affects the formation of usewear. Additionally, it is important to increase the duration of use for each tool to look for patterns of use over extended periods of time, as the duration and intensity in which a tool is used is known to affect the development of usewear. Developing and implementing additional experiments with cane is necessary to fully understand how cane would have been processed prehistorically and moreover how wear develops on tools during use. It is only through additional experimentation that we might be able to look more aggressively for patterns in usewear associated with cane processing in the archaeological record.

6.5 Results of High-power Analysis on Mussel Beach Flake Tools

The total sample of artifacts analyzed under high-power magnification included 308 flake tools, which were categorized as use-modified, retouched, and formally retouched based on the degree of edge damage. For this dissertation I decided to focus my analysis exclusively on flake tools for several reasons. First, expediently used flakes can often be overlooked in large lithic assemblages, and are therefore not included in many functional analyses. Unmodified, or minimally modified, flakes often constitute a large component of any lithic assemblage, but their identification requires that individual debitage specimens be analyzed at both macro and microscopic levels. Flake tools were also prioritized in this research over formal bifacial implements because of their association with women's work and domestic, or non-hunting related tasks, as suggested in many ethnographic contexts. Also, unmodified or retouched flakes may have been preferred tools for the myriad of everyday tasks occurring at short-term logistical camps or residential type sites. By focusing on flake implements, there is an opportunity to reveal a much wider range of tasks occurring and work being performed at an archaeological site. Finally, several studies have found that informal flake tools were more frequently utilized in the processing of plant and fibrous materials than formal endscrapers or bifaces (Hurcombe 1998, 2014; Logan 2014; Owen 1994, 2000). The processing of plant materials for non-subsistence activities, including the production of perishable material culture, also tends to be overlooked archaeologically because of the perishability of plant materials over time. The ability to recognize plant processing activities on non-perishable tools, like flakes for example, may help archaeologists shed light on plant use and perishable industries in the archaeological record.

The decision to focus on expedient flake tools, however, was made with an understanding that expedient technologies are not as heavily utilized as formally retouched tools. However, other expectations make expedient tools very amenable to functional analysis. The use-life of an expedient flake, for example, is expected to be much shorter than that of a biface or formal unifacial tool. Flake tools are often not intended to be used for more than the immediate task at hand, and once the task is complete, or when the flake is no longer efficient, it is discarded. While some flakes may have been repurposed or used for more than one task, the general trend for this type technology is that it is discarded soon after use. The implications, therefore, are that many of these tools may not exhibit extensive edge damage or usewear. In order for diagnostic usewear or polish to develop, tools must often be used for an extended period of time. All functional interpretations presented in this section are thus based on a combination of the morphological and technological analyses, low-power microscopy, and the high-power microscopic analysis.

In the following sections I provide the results of the usewear analysis for each tool per temporal component and summarize the results by contact materials. I also provide general functional trends for the flake tool assemblages and look for patterns or trends in flake blank selection with regards to tool function. With this size sample it was not possible to illustrate the usewear traces for each individual artifact examined, however microphotographs of several artifacts are included throughout this section. The tools chosen to be photographed are those which best exemplify a particular type of usewear. Artifacts are referenced using their assigned accession numbers. Low-power microwear observations for each of the individual flake tools examined are included in Appendix A and the high-power observations are available in Appendix B.

6.5.1 Late Archaic I

The sample of flake tools associated with the Late Archaic I temporal component consisted of 28 artifacts. Of the sample, 25 of the tools were classified as use-modified and three exhibited evidence for intentional retouching. Even though each of the artifacts in this sample exhibited wear patterns indicative of use, not all specimens analyzed under high-power magnification contained use-related polish or striations. Of the total sample, 3 (11%) tools lacked traces of micropolish, striations, and evidence of edge rounding (Acc. Nos. 0-292, 0-561, and 0-596). Under low-power magnification, these three specimens showed evidence of localized patterned edge-damage. Preliminary functional interpretations of these artifacts, based on the low-power examination, were that they were each used in a transverse motion on soft to medium contact materials. It is possible that these were used only briefly, perhaps tested for a particular task and discarded shortly thereafter. Of the remaining flake tool assemblage, 7 (25%) tools were found to have generic, or early stage polish, and 6 (21%) tools exhibited smooth-pitted type polish. At these stages of development, contact materials cannot be interpreted. Of the remaining 12 (43%) flake tools, use-action and contact material could be inferred based on a combination of flake scar termination and distribution, striation orientation, and polish morphology. Contact materials identified on the Late Archaic I flake tools include wood (3), bone/antler (n=5), fresh meat/fresh hide (n=4) (Figure 6.10). Table 6.2 summarizes the usewear results for the Late Archaic I flake tool assemblage.

Bone/Antler:

Five (n= 42%) flake tools from the Late Archaic I were identified as having been used on bone/antler. Four of the five tools were classified as use-modified, and one retouched, as it exhibited evidence for minor retouching on a lateral margin for prehension. Five of the tools were used in a transverse, or scraping motion. This motion was indicated by the presence of intense step fractures on only a single surface. The flake scars were also oriented perpendicular to the working edge, as were the striations and superficial streaks. Polish present on all five tools was limited to working edge, but was not distributed evenly on any of the tools. For the most part, the polish was isolated, located on the higher parts of the edge's topography.

Fresh Meat/Hide:

Contact with fresh meat and/or fresh hide was identified on four (n=33%) flake tools. Three of the four tools were classified as use-modified and one exhibited evidence for minor retouching which has been identified as being associated with hafting. With regards to use-motion, two of the tools were interpreted as having been used for cutting or sawing, as evidenced by the presence of small scalar scars and feather terminations on both the dorsal and ventral surface. While deep striations are limited on tools used to cut fresh meat, superficial streaks and shallow scratches were observed running parallel to the working edge. Of the remaining tools, one was used in a transverse motion and the others show evidence for both cutting and scraping. The macroscopic usewear on these artifacts was minimal, with the most obvious wear being

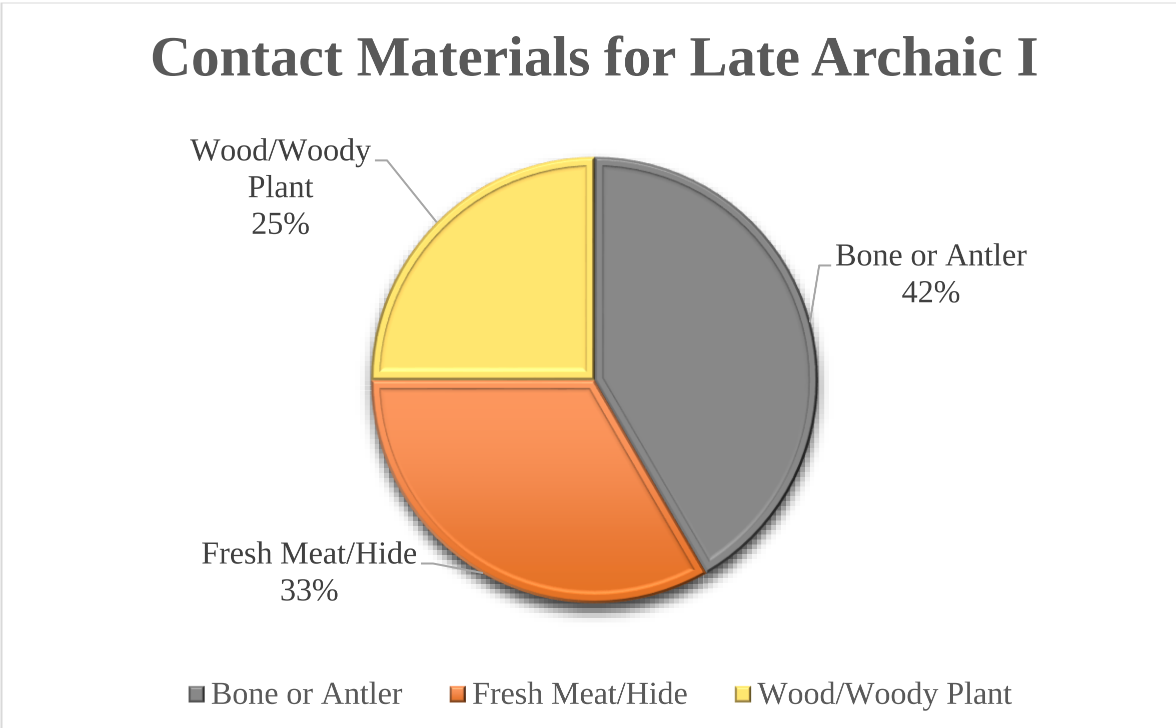


Figure 6.10: Summary of Contact Materials for Late Archaic I

Table 6.2: Summary of Contact Materials for the Later Archaic I Flake Tool Assemblage

Temporal Component	Contact Materials	Hard			Medium			Soft			Indeterminate
		Bone/Antler	Wood	Indeterminate	Hide	Soft Wood	Indeterminate	Fresh Meat/Hide	Plant	Indeterminate	
Late Archaic I	Use-Modified	4		8		2	5	3		2	
	Retouched	1				1		1			

small scalar and half-moon fracture scars. The polish identified on the tools was not always well developed, but the bright and often greasy appearance suggested contact with fresh meat/hide over any other type of contact material.

Wood:

Contact with wood or a woody plant was identified on the remaining three flake tools. Each of the tools were characterized as use-modified, and all were used in transverse type motions. Scraping motions, which were indicated on two of the tools, were interpreted based on the presence of flake scars on only one side of the tool. The flake scars were primarily scalar and hinge type, although step fractures were noted as well. Striations and other directional indictors were also orientated perpendicular to the working edge. The third tool was identified as having been used to grave or groove wood. The polish was very bright, appeared to be slightly raised above the surface of the tool, and for the most part exhibited a smooth texture. While polish ranged from fully to intermediately developed on these three tools, the location of the polish slightly away from the working edge, it's smooth but slightly raised texture, and the morphology of the fracture scars strongly suggested wood as the primary contact material.

6.5.2 Late Archaic II

The assemblage of flake tools recovered from the Late Archaic II phase consists of 51 artifacts, 44 (n=86%) of which were characterized as use-modified, 6 (n=12%) as retouched, and 1 (2%) as a formally retouched perforator or engraver. Of the total sample, only 2 (4%) flake tools lacked evidence of micropolish, striations, or edge rounding (Acc. Nos. 0-121 and 0-760). Under low-power magnification, specimen 0-121 was interpreted as having been used to scrape a hard contact material, and specimen 0-760 was interpreted as having been used to scape a soft to medium contact material. Both specimens exhibited patterned edge-damage indicative of use, but the lack of polish and/or striations suggesting that they may not have been used, or were perhaps used only briefly. Of the remaining flake tool assemblage, 19 (31%) tools were found to have generic, or early stage polish, and 11 (22%) tools exhibited smooth-pitted type polish, making contact materials difficult to determine beyond hardness. The remaining 19 (31%) flake tools, were found to have polish that ranged from intermediate to almost fully developed. By combining information obtained from the low-power microscopy, including flake scar termination, distribution, and orientation, with striation morphology and orientation, and polish texture and appearance, the use-action and contact material was inferred (Figure 6.11). Contact materials identified on the Late Archaic II flake tools include wood or woody plant (n=4), bone/antler (n=7), and fresh meat/fresh hide (n=8). Table 6.3 summarizes the usewear results for the Late Archaic II flake tool assemblage by flake tool type and contact material.

Bone/Antler

Seven (n= 37%) flake tools from the Late Archaic II were identified as having been used on bone/antler. All seven of these tools were classified as use-modified, showing no evidence for intentional retouching. As with most tools found to have been used to work bone or antler, these seven tools exhibited extensive edge damage in the form of medium to large step fractures, with no evidence of edge rounding. Six of the tools were used primarily in a transverse, or scraping motion, while the remaining tool (Acc. No. 0-581) showed evidence of both longitudinal and transverse actions, likely from butchering activities. The striations present on the scraping tools were oriented perpendicular to the working edge and ranged from relatively deep to superficial. Polish present on each specimen was limited to working edge, occurring primarily in isolated patches. Figure 6.12, an image of artifact 0-581, illustrates intermediately developed bone polish with perpendicular directional indicators.

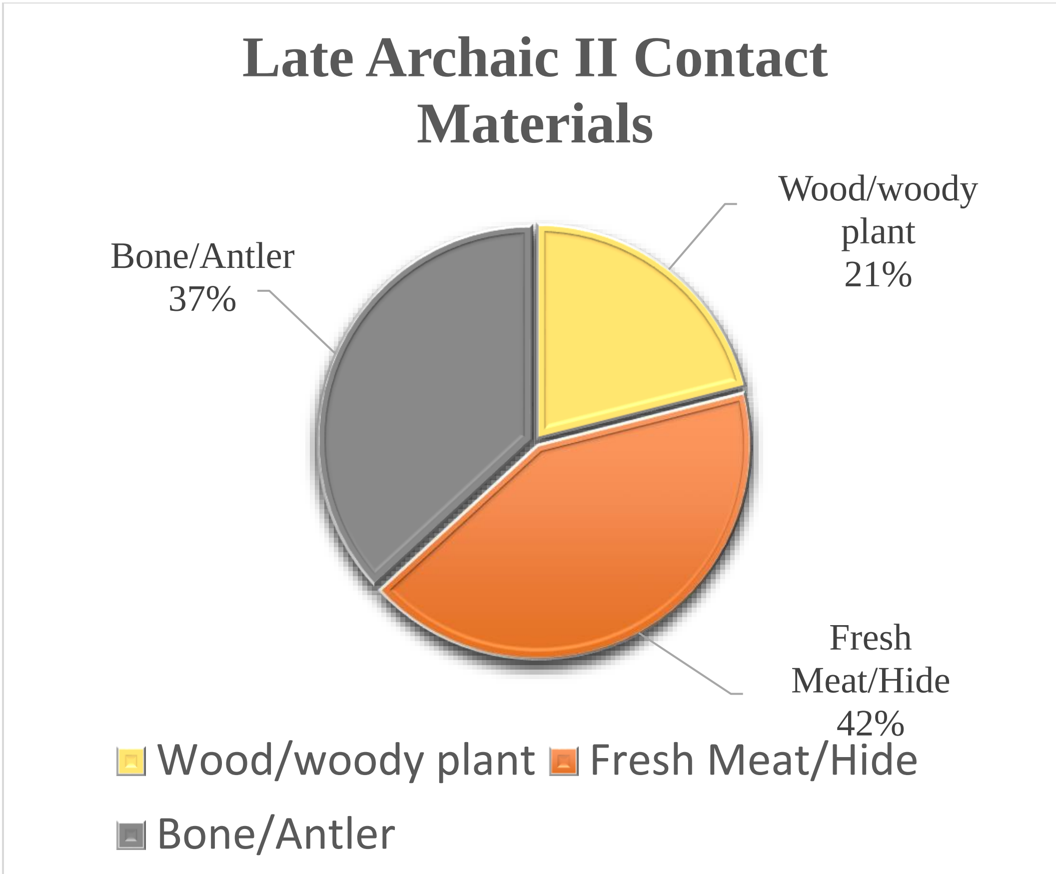


Figure 6.11: Summary of Late Archaic II Contact Materials Inferred from High-power Analysis

Table 6.3: Summary of Contact Materials for Flake Tool Type Associated with the Late Archaic II Occupation

Temporal Component	**Contact Materials**	**Hard**			**Medium**			**Soft**			**Indeterminate**
		Bone/Antler	**Wood**	**Indeterminate**	**Hide**	**Soft Wood**	**Indeterminate**	**Fresh Meat/Hide**	**Plant (Woody)**	**Indeterminate**	
Late Archaic II	**Use-Modified**	7		5		2	20	7	1		
	Retouched		1	1			1	1			2
	Formal Retouched										1

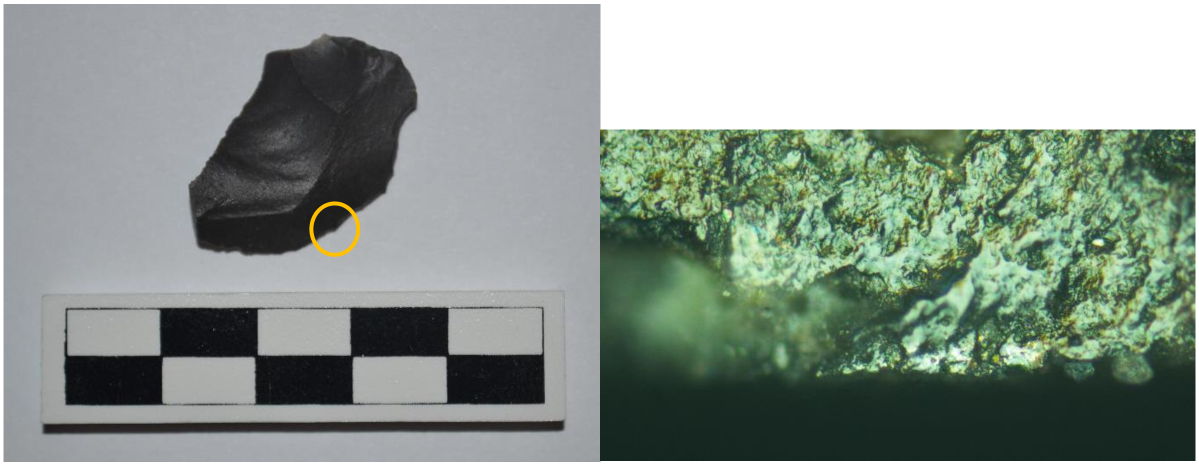


Figure 6.12: Bone Polish and Directional Indicators (R) on Use-Modified Flake (Acc. No. 0-581). Circle indicates location of usewear. (R) (200x magnification).

Fresh Meat/Hide

Contact with fresh meat and/or fresh hide was identified on eight (n=42%) of the Late Archaic II flake tools. Seven of the eight tools were classified as use-modified and one exhibited evidence for minor retouching which has been identified as being associated with hafting (Figure 6.13). With regards to use-motion, four of the tools were interpreted as having been used for cutting or sawing, as evidenced by the presence of small scalar and feather scars on both the dorsal and ventral surface. Of the remaining tools, three were used in a transverse motion and one exhibited evidence for both cutting and scraping. Although the macroscopic usewear on these artifacts was minimal to moderate, all eight are believed to have been used as butchering implements. The polish identified on the tools ranged from bright and greasy, to slightly dull and matt. The difference is likely attributed to differential contact with meat, bone, and fresh hide.

Wood

Contact with wood or a woody plant was identified on the remaining four flake tools. Three of the flake tools were characterized as use-modified, and one exhibited evidence of

Figure 6.13: Artifact No. 0-087, Use-modified Flake with Evidence of Minor Retouching. Arrows Indicate Locations of Haft-related Flake Scars.

retouching on the distal end of the flake to create a flat inset surface for scraping. Three of the four flake tools were used primarily to scrape a soft or medium grade wood. The flake scars are primarily hinged, with some minor stepping on the working edge. The last flake tool (Acc. No. 0-649) showed evidence of having been used in both longitudinal and transverse motion on a much softer woody material. Flake scars on this tool ranged from half-moon and scalar scars to hinge fractures. Striations and other directional indictors were orientated perpendicular and parallel the working edge (Figure 6.14). The polish was also very bright, and where developed, appeared to be slightly raised above the surface of the tool. It was located primarily away from the working edge within fracture scars and on the interior ridge of some fracture scars. Polish on all four tools ranged from generic to intermediate and fully developed, which might indicate that none of the tools were used for an extended period of time. Polish, however, does form much slower when working softer contact materials like wood or woody plants. The working of

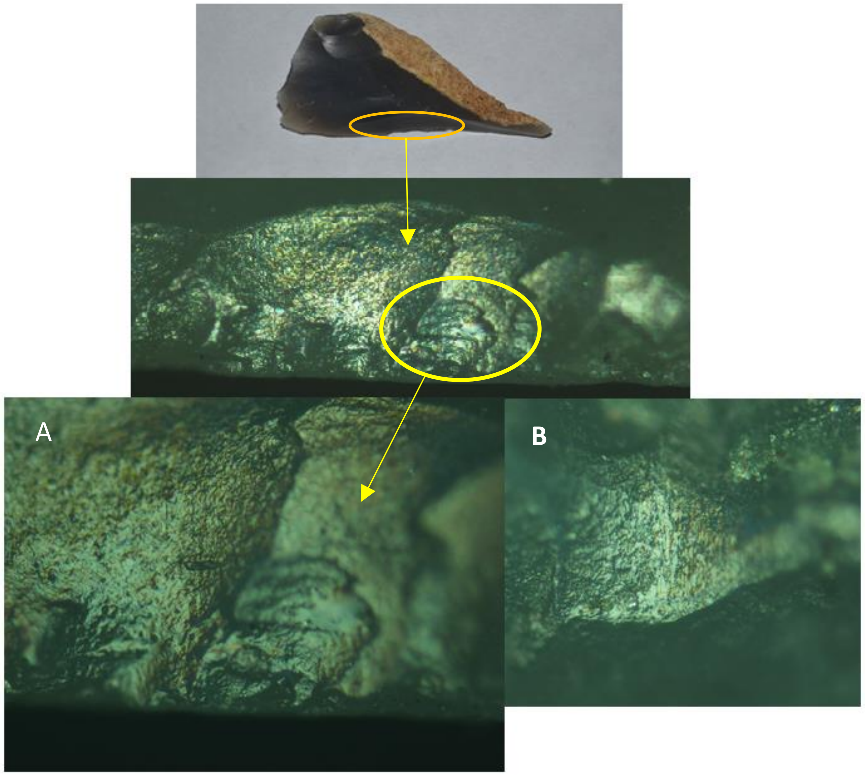


Figure 6.14: Woody-type Polish on the Working Edge of Specimen 0-0649. (A) 100x Magnification of Working Edge Showing Hinge Fractures and Bright Polish Away from Edge;, (B) 200x Magnification of Polish Showing Parallel Directional Streaks and Polish; (c) 200x Magnification of Perpendicular Streaks

a soft wood might not result in well-developed polish even if the tool is used extensively. Overall, however, the more developed polish exhibited a smooth, but slightly raised texture that is indicative of wood or a woody plant.

6.5.3 Late Archaic III

The assemblage of flake tools recovered from the Late Archaic III cultural component contained 119 flake tools, 103 (n=87%) of which were characterized as use-modified, 12 (n=10%) were retouched, and 3 (3%) were categorized as formally retouched perforators/microdrills. Of the sample, 18 (16%) flake tools lacked evidence of micropolish, striations, or edge rounding, although based on the degree and patterning of microfractures, they are believed to have been utilized. Specimens 0-226 and 0-899, for example, are both formally retouched perforators with broken distal ends, and two flake tools have been identified as wedges (Acc. No. 0-060 and 0-505), as they exhibit extensive step fracturing and edge blunting on opposing flake margins. Of the remaining flake tool assemblage that contained use-related polish, 48 (40%) tools were found to have generic, or early stage polish, and 16 (14%) tools exhibited smooth-pitted polish. No attempt was made to interpret specific contact materials on these artifacts. The remaining 37 (30%) flake tools, exhibited polish ranging from intermediate to fully developed. Compared to the Late Archaic I and II samples, flake tools associated with the Late Archaic III appear to have been utilized for longer periods of time, or at least long enough to develop diagnostic-type polish. Interpretation of contact materials were again based on polish texture and morphology, as well as flake scar termination, distribution, and orientation, degree of edge rounding, and striation morphology and orientation. Contact materials identified on the Late Archaic III flake tools include wood (n=10), bone/antler (n=13), fresh meat/fresh hide (n=8), hide (3), and plant (n=3) (Figure 6.15). Table 6.4 summarizes the usewear results for the Late Archaic III flake tool assemblage by flake tool type and contact material.

Wood

Contact with wood or a woody plant was identified on ten flake tools (n=28%). Eight of the flake tools were characterized as use-modified, and two exhibited (Acc. No. 0-062 and 0-217) evidence of retouching. Specimen 0-062 exhibited retouching on the lateral margin which created a crescent shape similar to that of a spoke shave. The presence of perpendicular striations and polish along the working edge indicates that the tool was used to scrape wood. Flake tool 0-217 exhibited a denticulated or serrated lateral margin. Intermediately developed polish was located in isolated patches on the most distal end of the serrations, as were parallel

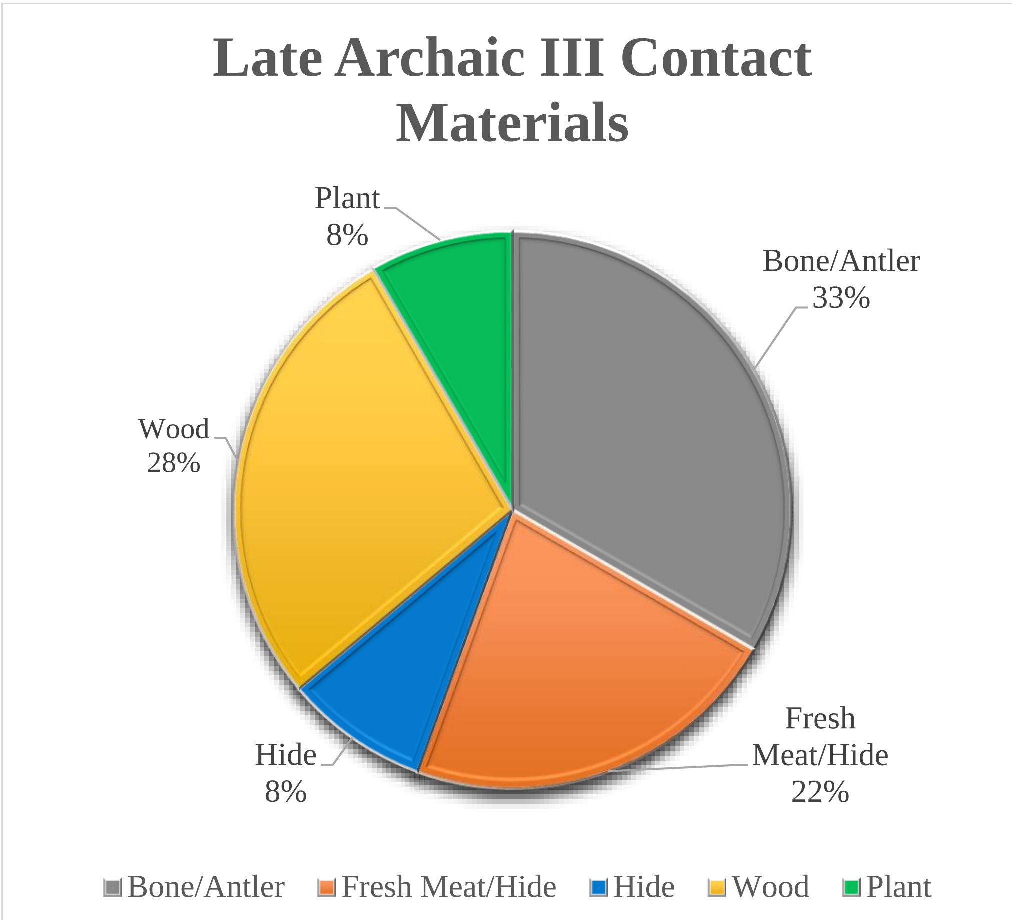


Figure 6.15: Summary of Contact Materials Identified on Late Archaic III Flake Tools

Table 6.4: Summary of Contact Materials for Late Archaic III Flake Tools

Temporal Component	**Contact Materials**	**Hard**			**Medium**			**Soft**			**Indeterminate**
		Bone/Antler	**Wood**	**Indeterminate**	**Hide**	**Soft Wood**	**Indeterminate**	**Fresh Meat/Hide**	**Plant (Woody)**	**Indeterminate**	
Late Archaic III	**Use-Modified**	10		9	2	8	31	8	3	31	1
	Retouched	2		2	1	2	4			2	2
	Formal Retouched									1	

streaks. Evidence indicates that this tool was likely used to cut or saw a soft wood or a woody plant. The polish is located primarily on the tip of a small protrusion and contains striations running perpendicular to the edge. Seven of the remaining flake tools were used to scrape a soft or medium wood. The flake scars are primarily hinged, however some minor stepping on the working edge was noted. The last flake tool (Acc. No. 0-763) showed evidence of having been used as graver or grooving tool on a softer wood.

Bone/Antler

Twelve (n= 33%) flake tools from the Late Archaic III were identified as having been used on bone/antler. Ten of these tools were classified as use-modified, showing no evidence for intentional retouching, while two tools exhibited minor retouching which was interpreted as having been associated with tool prehension or possibly hafting. In total, eight of the Late Archaic III tools were used on bone/antler in a transverse, or scraping motion, two showed evidence for longitudinal actions, and two exhibit evidence for both longitudinal and transverse motions. The tools all contain areas with extensive step fracturing associated with the working of a hard material, and areas with deep striations. Polish was located primarily on the working edge, and ranged from fully developed to weak generic in some patches. Many of these tools are believed to have used in butchering related activities.

Fresh Meat/Hide

Contact with fresh meat and/or fresh hide was identified on eight (n=22%) of the Late Archaic III flake tools. All eight of the tools were classified as use-modified, with no evidence of retouching. The majority of these flake tools (n=5) showed evidence of having been used as both cutting and scraping tools. Only one was interpreted as being used primarily in a transverse motion, and two primarily in a longitudinal direction. All eight tools are believed to have been used as butchering implements, containing polish that ranged from bright and greasy, to slightly dull and matt. The macroscopic edge damage was minimal on locations used to cut through fresh hide/meat, but was more extensive on portions of the tools that came in contact with bone.

Hide

Contact with dry or greased hide was identified on three (n=8%) of the Late Archaic III flake tools. Two of the tools were classified as use-modified (Acc. Nos. 0-081, 0-082), while the third was a formally retouched tool (Acc. No. 0-902). The two use-modified flakes showed evidence of having been used in a transverse motion. The edges of these tools show evidence of rounding, and both contain superficial striations and directional indicators which run perpendicular to the working edge (Figure 6.16). The third tool, identified as a perforator preform, showed evidence of having been used in a projection-type motion. This is evidenced by the presence of parallel streaks oriented away from the tip of the perforator (Figure 6.17). The polish on each of these tools has a rough or bumpy texture, but is not heavily pitted. For the most part, the polish is dull or matte, but retains a greasy appearance. It is not distributed evenly across the working edge, which suggests that the tools were not used for prolonged periods of time.

Plant

Three (n=8%) flake tools from the Late Archaic III occupation show evidence of having been in direct contact with a silica-rich plant. All three of the flake tools are categorized as use-modified, showing no evidence of retouching for hafting or prehension. Two of the tools (Acc. No. 0-878 and 0-142) were interpreted as having been used primarily in a transverse motion. Macroscopic edge damage on these artifacts is minimal to moderate and is characterized primarily by the presence of small to medium scalar and feather scars on a single working edge.

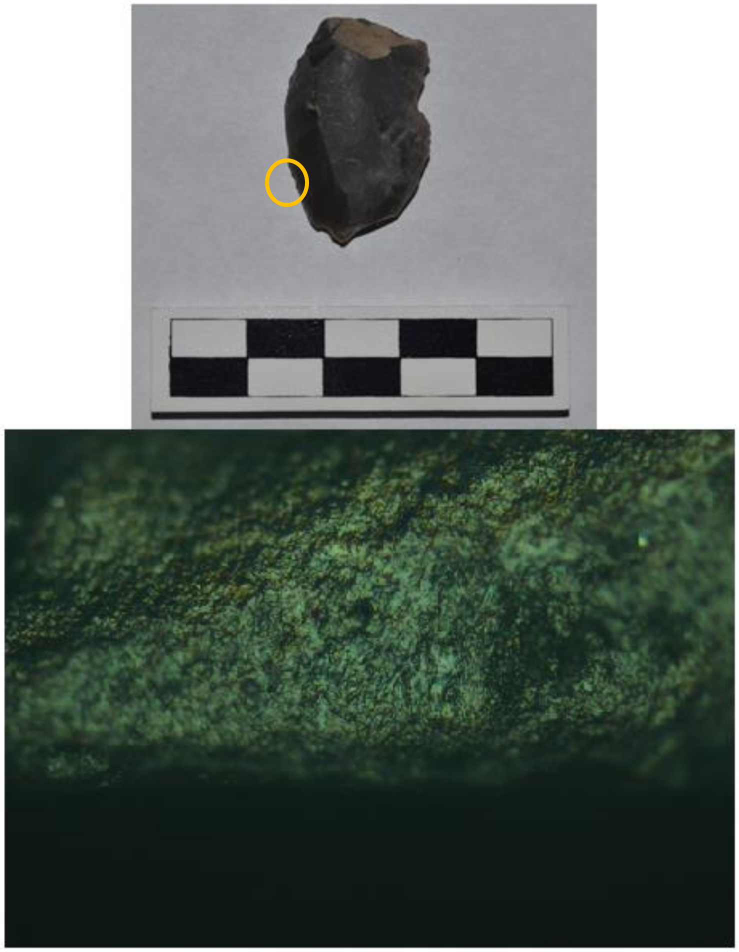


Figure 6.16: Hide Polish with Striations Running Perpendicular to the Working Edge on Artifact 0-082 (200x magnification).

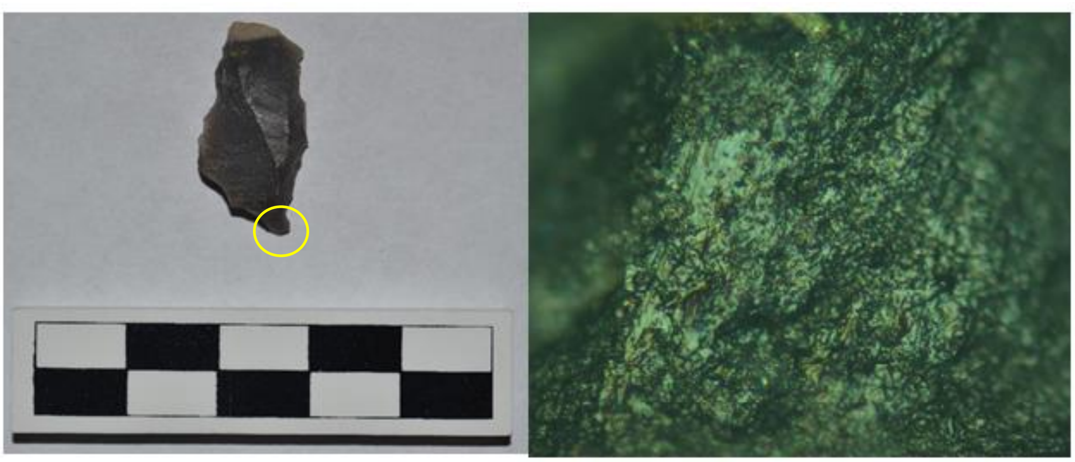


Figure 6.17: Hide Polish and Perpendicular Streaks on Distal End of Perforator Tool 0-902 (200x magnification)

The third tool (Acc. No. 675) exhibited alternating flakes scars on both the dorsal and ventral surface of the working edge, which is evidence that the tool used in both a transverse and longitudinal direction. The presence of parallel and superficial striations within the polish supports this interpretation. The working of soft to medium plants rarely results in the formation of deep striations, however clear directional indicators are likely to develop within the polish if the tool is used extensively.

Microscopically, each of these artifacts contain slightly rounded working edges, which is again indicative of the working of a softer contact material. The polish developed in small to medium patches that were extremely bright and highly reflective against the natural stone surface. Although the patches of polish are not linked, they appear along the entire working edge. Based on polish morphology, texture, and overall distribution along the working edge, the plant polish is believed to be in an intermediate stage of development, although there are patches which are considerably less developed. Although characteristic "comet-tails" are visible within the polish on artifacts 0-142 (Figure 6.18) and 0-675 (Figure 6.19), it is not as invasive or widespread as fully developed plant polish or as fluid as sickle gloss.

6.5.4 Middle Woodland

The assemblage of flake tools recovered from the Middle Woodland cultural occupations include a total of 110 flake tools, 89 (n=81%) of which were characterized as use-modified, 18 (n=16%) were retouched, and 2 (2%) were categorized as formally retouched tools. Of the sample, 7 (6%) flake tools lacked evidence of micropolish, striations, or edge rounding. Five of these artifacts have been characterized as retouched, each having been shaped into perforators or graving tools. The distal end of two of the implements (Acc. No. 0-201 and 0-921) appear to be missing, perhaps broken during use or after discard (Figure 6.20). The remaining two artifacts,

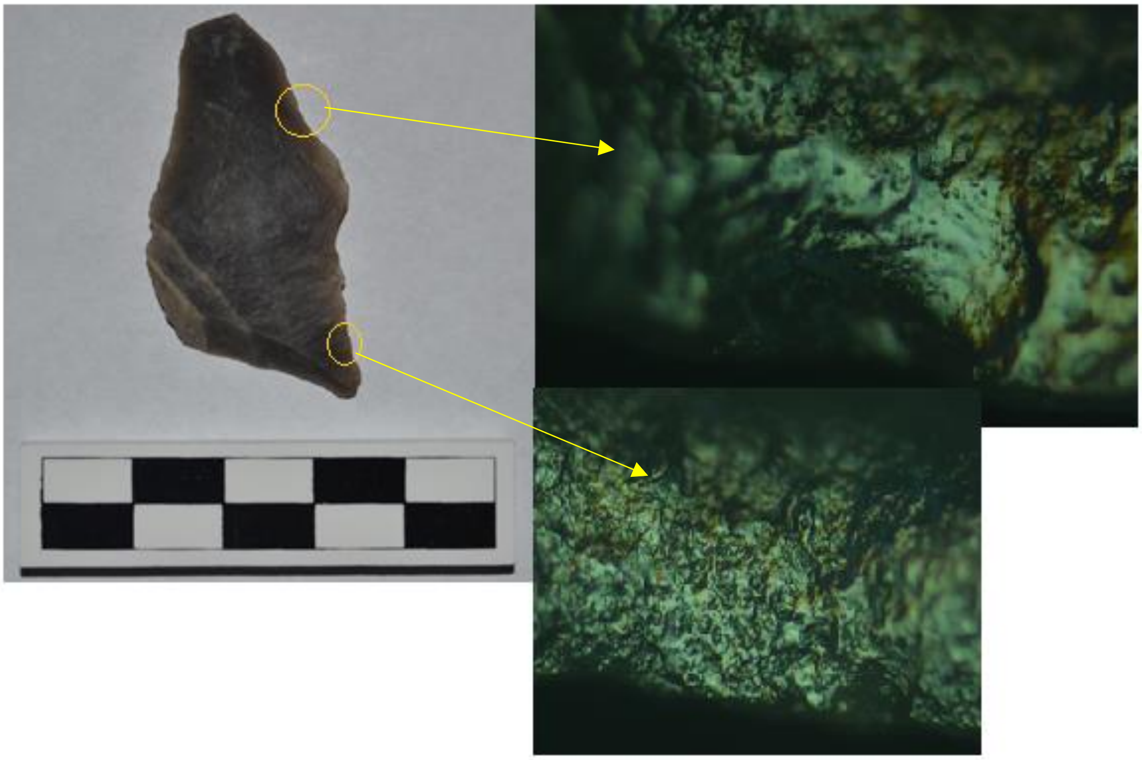


Figure 6.18: Plant Polish in Early and Intermediate Stages of Development on Artifact 0-675 (200x Magnification).

Figure 6.19: Plant Polish in Intermediate Stages of Development on the Working Edge of Artifact 0-142 (200x Magnification)

Figure 6.20: Retouched Perforators/Gravers from Middle Woodland; (A) Acc. No. 0-921 (B) Acc. No. 0-201

classified as use-modified, contain patterned microfractures and edge damage indicative of use on medium to hard contact materials. Of the remaining flake tool assemblage, 103 (94%) artifacts contained use-related polish, however 31 (30%) of the tools were found to have generic, or early stage polish, and 18 (17%) tools exhibited smooth-pitted polish. There was no attempt to interpret specific contact materials on these artifacts. The remaining 54 (52%) flake tools, exhibited polish which ranged from intermediate to fully developed. Contact materials include wood or a woody plant (n=11), bone/antler (n=20), fresh meat/fresh hide (n=12), dry or greased hide (6), and plant (n=5) (Figure 6.21). Table 6.5 summarizes the usewear results for the Woodland flake tool assemblage by flake tool type and contact material.

Wood

Contact with wood or a woody plant was identified on 11 flake tools (n=21%). Eight of the twelve flake tools were characterized as use-modified, and three exhibited evidence of retouching. Specimen 0-165 exhibited retouching on the lateral margin, creating a crescent shape similar to that of a spoke shave, and the retouching on tool Acc. No. 0-315 is likely related to prehension. All ten of the tools contain perpendicular striations, streaks, or directional

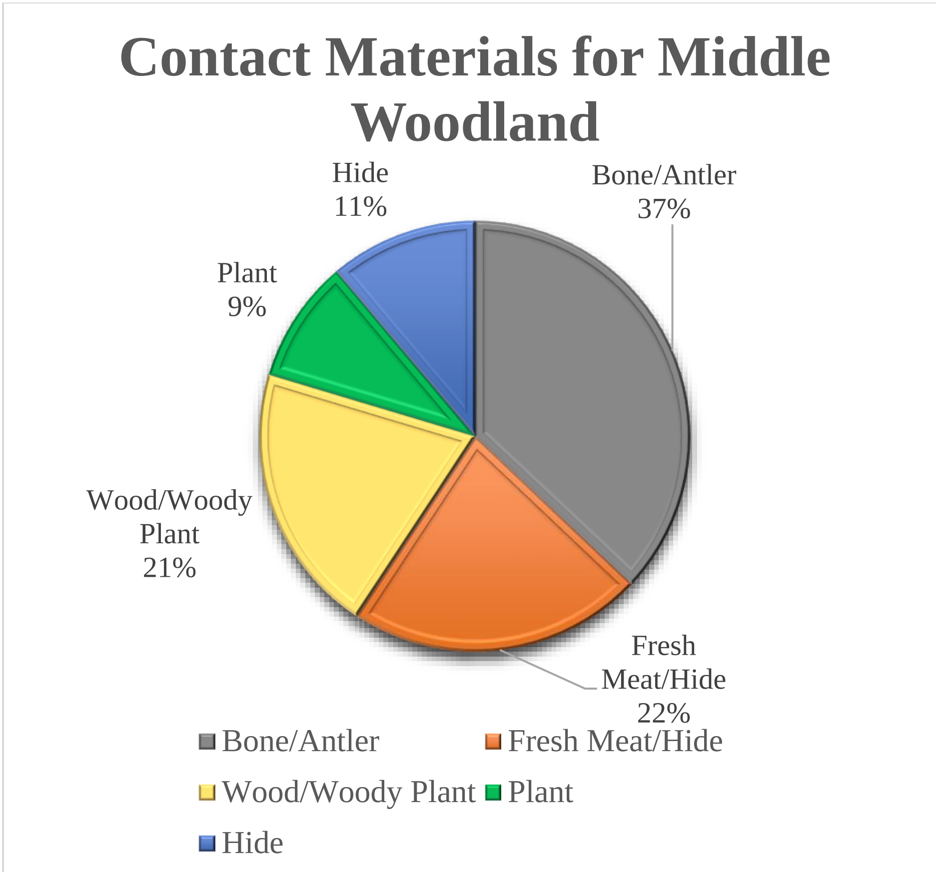


Figure 6.21: Summary of Contact Materials on Middle Woodland Flake Tools

Table 6.5: Summary of Contact Materials for Middle Woodland Flake Tools

Temporal Component	Contact Materials	Hard			Medium			Soft			
		Bone/Antler	Wood	Indeterminate	Hide	Soft Wood	Indeterminate	Fresh Meat/Hide	Plant (Woody)	Indeterminate	Indeterminate
Middle Woodland	**Use-Modified**	18		20	6	8	9	11	5	10	2
	Retouched	2		2	1	2	4			2	2
	Formal Retouched									1	1

indicators running perpendicular to the working edge, which indicates that the tools were used for scraping. The polish on the artifacts ranges from a bright and voluminous to a domed and highly pitted. The polish was primarily located away from the working edge, along the inner margins of half-moon, scalar, and hinge terminations. Because not all of the polish was fully developed on all tools, it was difficult to differentiate between wood and plant.

<u>Bone/Antler</u>

Twenty (n= 37%) flake tools from the Middle Woodland occupations were identified as having been in contact with bone or antler. Eighteen of these tools were classified as use-modified, one exhibited evidence for minor retouching, and tool (Acc. No. 0-224) was classified as formally retouched because of extensive retouching along each of the flake margins. A transverse, or scraping motion, was noted on 10 tools, 1 tool showed evidence for longitudinal actions, and 7 flakes exhibited evidence for both longitudinal and transverse motions. The polish on most of the tools was located primarily on the working edge, within flake scars, and flake ridges, and ranged from fully developed to intermediate, and generic in some patches. The tools found to have evidence of both longitudinal and transverse use actions were likely utilized in butchering activities, as many of the tools not only have polish that was in different stages of development, but polish that ranged from rough and dull to bright and reflective (Figure 6.22).

<u>Fresh Meat/Hide</u>

Contact with fresh meat and/or fresh hide was identified on twelve (n=22%) flake tools associated with the Middle Woodland. Eleven of the tools were classified as use-modified, with no evidence of retouching, and one tools exhibited minor retouching likely associated with hafting or prehension. With regards to use action, five tools showed evidence for longitudinal motions, three for primarily transverse motions, and four exhibited evidence for both cutting and

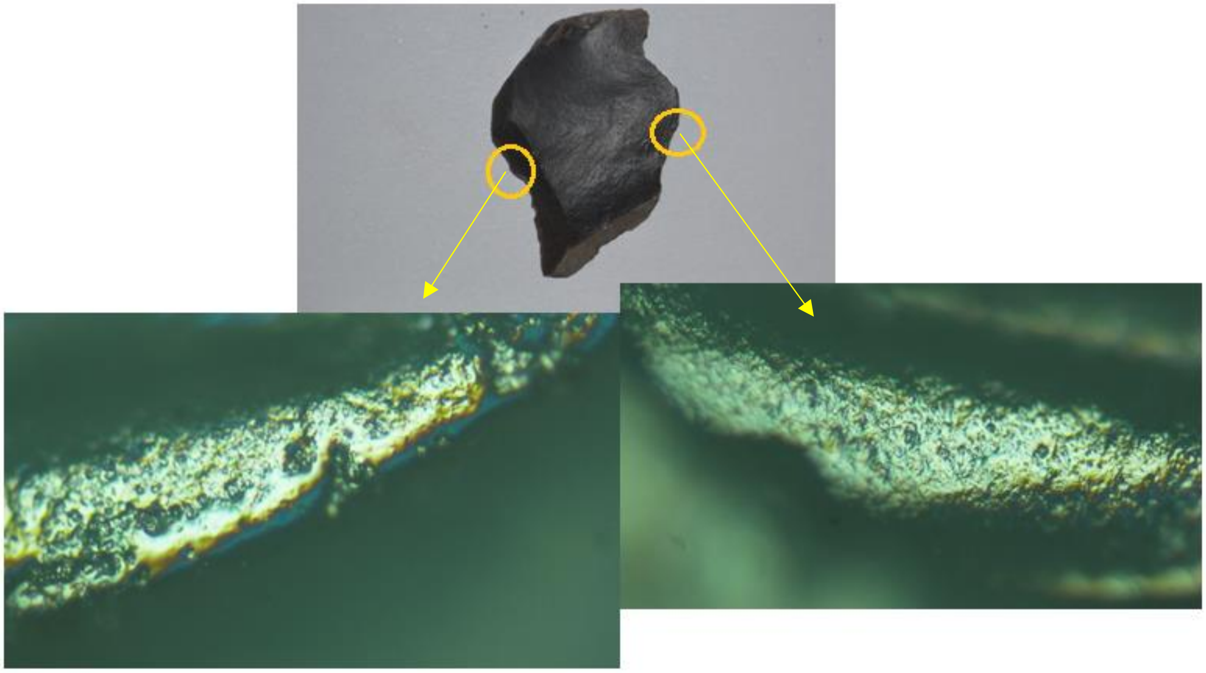


Figure 6.22: Bone Polish in Different Stages of Development on Tool 0-648 (200x)

scraping activities. Tools used for cutting or sawing fresh meat or hide exhibited minimal macroscopic edge damage, however, parallel streaks and directional indicators were visible under high-power magnification (Figure 6.23). All of the tools are believed to have been used as butchering implements, as they contain polish that ranged from bright and greasy, to slightly dull and matte depending upon the amount of contact with bone.

Hide

Contact with dry or greased hide was identified on six (n=11%) of the Middle Woodland flake tools. All six of the tools were classified as use-modified, although one of the tools exhibited a pointed working edge that may have been produced during use or as the result of retouching (Acc. No. 0-063). Five of the use-modified flake tools showed evidence of having been used in a transverse motion, and the pointed tool, identified as a possible perforator, is

Figure 6.23: Fresh Meat/Hide Polish and Parallel Directional Indicators on Working Edge of Tool 0-231.

believed to have been used in a projection-type motion. The polish on the majority of these tools was rough in texture, with a dull appearance. The distribution and development of the polish on the working edge suggests that the tools were not used for prolonged periods of time. In general, flake tools are the most efficient for the initial stages of hide processing when a sharp edge is needed, but are likely not utilized in later stage processing when the hide is susceptible to tearing.

Plant

A total of five (n=10%) Middle Woodland flake tools were interpreted to have been in contact with soft, silica-rich plants. All five of the tools are categorized as use-modified, and there is no evidence for intentional retouching. In terms of use action, two artifacts show evidence of transverse motions, one exhibits evidence for longitudinal use action, and two exhibit evidence for both cutting and sawing activities. The macroscopic edge damage on the tools ranges from small feather and scalar scars to small half-moon fractures. Microscopically, each of these artifacts contain slightly rounded working edges and patches of polish that ranges bright, smooth, and reflective to bright and heavily pitted. Superficial streaks running perpendicular and parallel to the working edge support use-action interpretations. Based on polish morphology, texture, and overall distribution along the working edge, the plant polish is believed to be in early and intermediate stages of development (Figure 6.24). Polish tends to be located within half-moon scars along the inner edge of rounded crests, slightly away from the working edge. Directional indicators can also be seen running perpendicular to the working edge (Figure 6.25). While this interpretation is tentative, the location, texture, and appearance of the polish looks similar to that of polish observed on the experimental flake tools (Exp-01 and Exp-05) used to peel river cane (see Figures 6.3 and 6.4). In general, however, the plant polish on the Middle Woodland flake tools is less developed, indicating that the tools were not used extensively before they were discarded.

6.6 Flake Tool Use at Mussel Beach (40MI70)

Expedient flake tools represent a rather simple form of technology, however it is clear that they were incorporated into the technological system at Mussel Beach by the many different groups visiting the site throughout the Archaic and Woodland periods. The re-analysis of the entire debitage assemblage (n=28,132) revealed that flake tools were not only more abundant than previously thought, but they are an important component of the lithic assemblage, and were likely involved in the manufacture of other tools and items of material culture. In total, 309 flake tools were analyzed under high-power magnification for use-related wear, including polish,

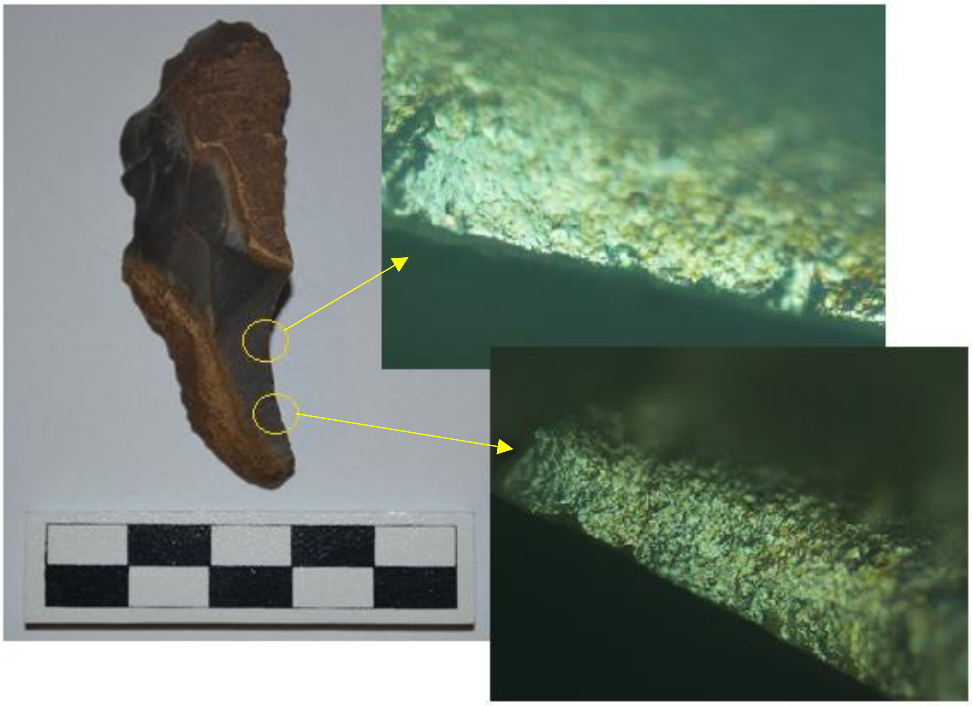


Figure 6.24: Possible Plant Polish in Early (Bottom) and Intermediate (Top) Stages of Development on Acc. No. 0-260 (200x Magnification)

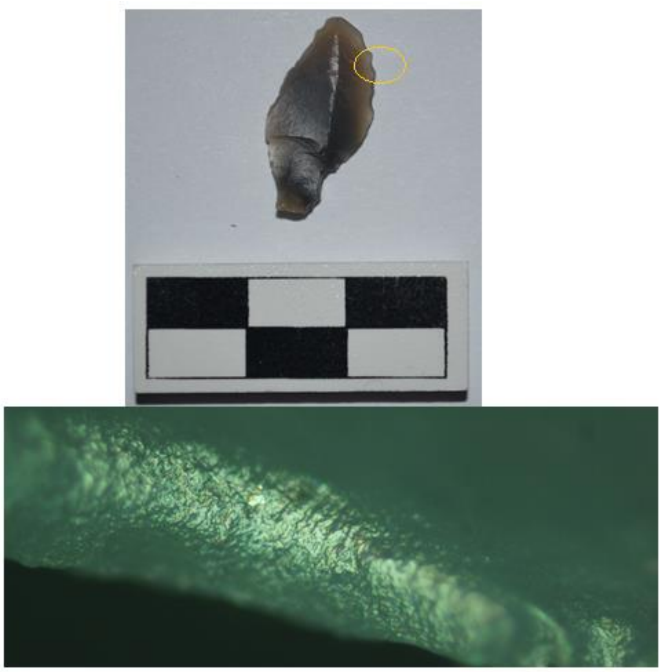


Figure 6.25: Possible Plant Polish Located within Inner Crest of Half-Moon Fracture Scar on Tool No. 0-375 (200x Magnification)

striations, and edge rounding. The majority of the flake tools within the Mussel Beach assemblage were classified as use-modified (85%), meaning that they were utilized without having been intentionally shaped or retouched. Thirty-nine (13%) flake tools exhibited some form of intentional retouching and the remaining 7 (2%) artifacts showed evidence for extensive retouching and edge modification.

The usewear analysis revealed that flake tools were used to cut, scrape, perforate, and engrave or groove a variety of materials. Figure 6.26 shows that, with regard to use action, flake tools were most frequently utilized as scraping (68%) implements. Cutting or sawing (14%) represents the second most common activity, and several tools show evidence for both longitudinal and transverse motions (6%). Graving (4%) and projection/perforation (7%) is also common among the Mussel Beach flake tools. It should be noted, however, that the wear patterns associated with both graving and perforation can be similar, and therefore the results of the usewear represent interpretations rather than absolute designations. The final use action observed among the flake tools is wedging (1%), although it was only represented on a small sample of tools.

Having more accurately determined tool function through the high-power functional analysis, it is now possible to begin to look for relationships or patterns in tool selection and tool use. I look first at the relationship between flake tool function and raw material type in an effort to determine if raw material type played a role in the selection of tools for different tasks. A Chi-Square test for independence was used to test the functional variables cutting, scraping, graving, perforating, and wedging against each of the raw materials types identified at Mussel Beach (Table 6.6). The results of the Chi-Square indicate that use action and raw material are not mutually exclusive, meaning that raw material did not directly influence how a flake tool was

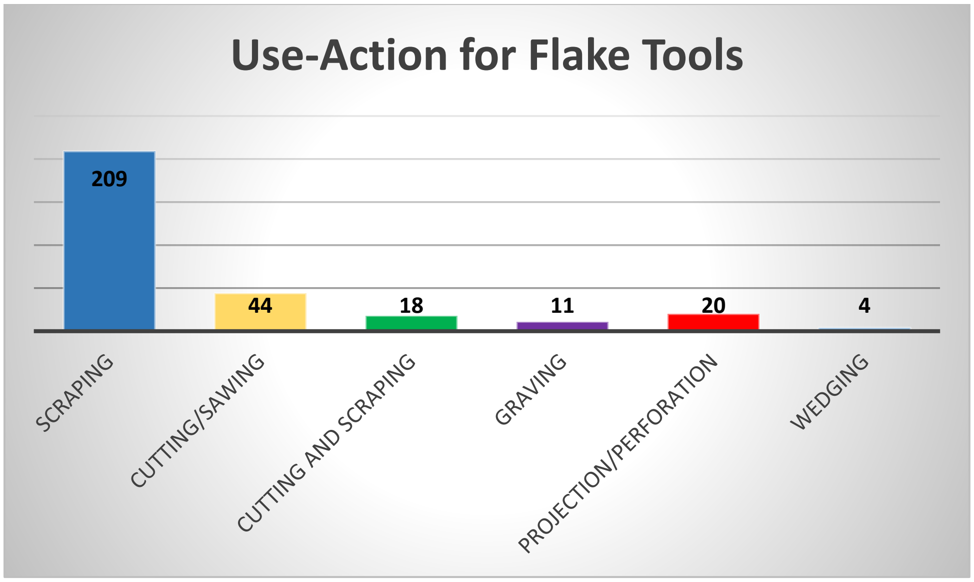


Figure 6.26: Summary of Flake Tool Use According to Use-Motion

Table 6.6: Chi-Square Test of Independence between Raw Materials and Flake Tool Use Action

Raw Material	**Scraping**	**Cutting**	**Both**	**Graving**	**Wedging**	**Projection**	**Unsure**	**Totals**
Fort Payne	41 (44)	7 (9.3)	4 (3.8)	2 (2.3)	2 (.8)	8 (4.2)	1 (.4)	65
Knox	24 (24.5)	6 (5.2)	2 (2.0)	1 (1.3)	0 (.5)	2 (2.3)	1 (.2)	36
Bangor	73 (75.3)	19 (15.9)	6 (6.5)	6 (4.0)	1 (1.4)	6 (7.2)	0 (.8)	111
St. Louis	14 (12.2)	2 (2.6)	1 (1.1)	0 (.6)	0 (.2)	1 (1.2)	0 (.2)	18
Monteagle	40 (40.0)	10 (8.4)	4 (3.4)	2 (2.1)	1 (.8)	2 (3.8)	0 (0)	59
Heated	6 (4.8)	0 (1.0)	0 (.3)	0 (.1)	0 (.1)	1 (.5)	0 (0)	7
Chalcedony	4 (2.7)	(.6)	0 (.1)	0 (.1)	0 (.1)	0 (.3)	0 (0)	4
Unidentified	7 (5.4)	0 (1.1)	1 (.5)	0 (.3)	0 (.1)	0 (.5)	0 (0)	8
Totals	**209**	**44**	**18**	**11**	**4**	**20**	**2**	**308**

(X^2=39.67, df=63, *P*=.991)

used (Table 6.7) This is not surprising given the similarities in chert types available at the Mussel Beach site. Although there are minor differences in grain size and relative coarseness, all of the cherts utilized at Mussel Beach are of a high quality.

In addition to investigating the relationship between tool action and raw material, the relationship between tool action and tool type (i.e., use-modified, retouched, and formally retouched) was also assessed using a Chi-Square test for independence (Table 6.8). When the variables use-action and tool type were assessed, the results of the Chi-Square were significant (Table 6.9). Use-modified flakes, while used in a variety of ways, are utilized most frequently in a scraping motion. They do not often function as perforators, in fact they are used much less frequently as projection tools. The retouched and tools are also used frequently in a scraping motion, but tend to be used as perforators or drills more frequently than expected. The formal tools have previously been defined as more specialized implements and do not appear to function as scrapers or cutting tools. They are, for the most part, used in a projection motion.

Of the total sample of flake tools examined under high-power magnification, diagnostic polish was identified on 122 (66%) of the artifacts analyzed. The results indicate that flake tools were utilized on a range of contact materials, including bone/antler, wood, hide, fresh meat/hide, and plant. Figure 6.27, which illustrates the frequency of contact materials, shows that bone/antler is the primary contact material (37%) and this followed closely by fresh meat/hide (26%). Flake tools were also found to have been used frequently on wood or a woody type plant (23%), but much less frequently on dry or greased hide (7%) and soft silica-rich plants (7%).

While the working of bone/antler appears to be the dominant activity in which flake tools were utilized at Mussel Beach, it is important to note that the working of hard contact materials like bone is often overrepresented, as wear tends to accumulate much faster on harder contact

Table 6.7: Results of the Chi-Square Test of Independence between Raw Material and Use-action.

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	39.667[a]	63	.991
Likelihood Ratio	38.919	63	.993
Linear-by-Linear Association	5.172	1	.023
N of Valid Cases	308		
a. 69 cells (86.3%) have expected count less than 5. The minimum expected count is .01.			

Table 6.8: Chi-Square Test of Independence between Use-Action and Flake Tool Type

Use-Action	Use-modified	Retouched	Formally Retouched	Totals
Scraping	188 (177.8)	20 (26.5)	1 (4.8)	209
Cutting	41 (37.4)	3 (5.6)	0 (1.0)	44
Both	15 (15.3)	3 (2.3)	0 (.4)	18
Graving	7 (9.4)	4 (1.4)	0 (.3)	11
Wedging	3 (3.4)	1 (.5)	0 (.1)	4
Projection	7 (17.0)	7 (2.5)	6 (.5)	20
Unsure	1 (1.8)	1 (.2)	0 (0)	1
Totals	**262**	**39**	**7**	**308**

(X^2=103.14, df=14, *P*=.000)

Table 6.9. Results of the Chi-Square Test of Independence between Use-action and Flake Tool Type

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	103.142[a]	14	.000
Likelihood Ratio	53.678	14	.000
Linear-by-Linear Association	61.086	1	.000
N of Valid Cases	308		
a. 17 cells (70.8%) have expected count less than 5. The minimum expected count is .02.			

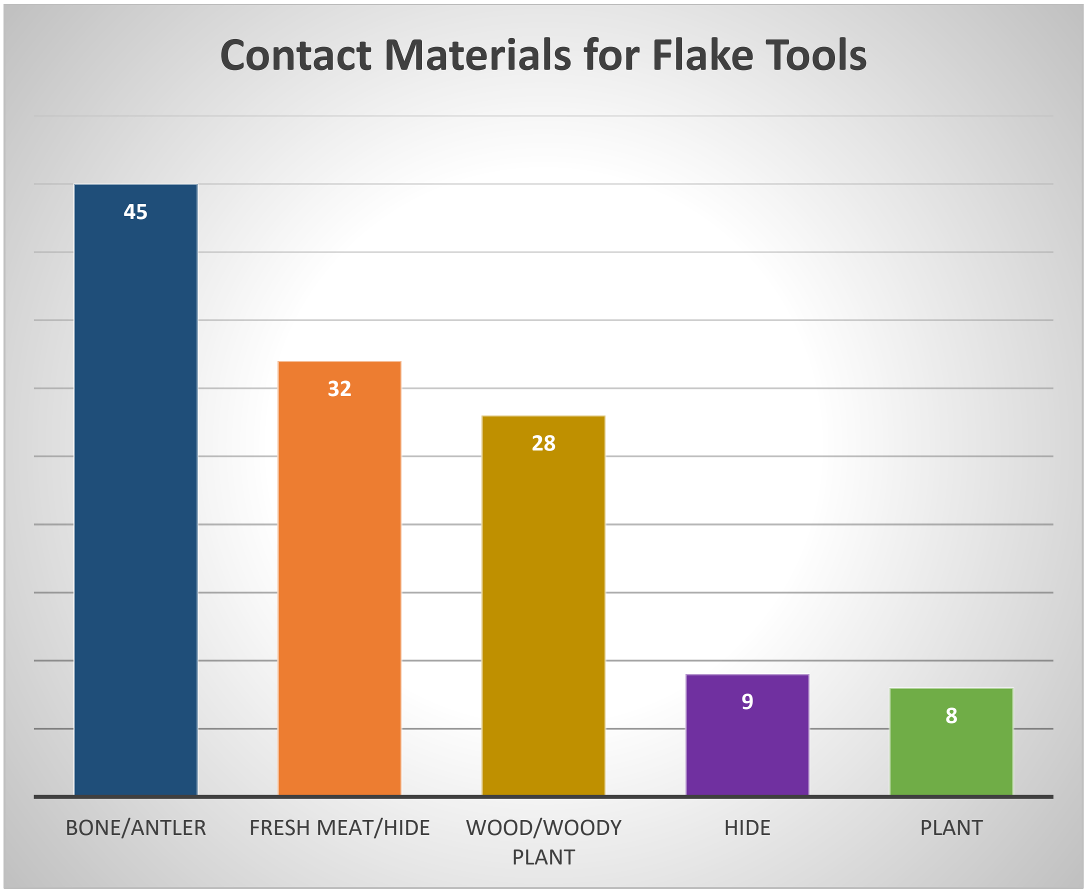


Figure 6.27: Summary of Contact Materials on Flake Tools from Mussel Beach

materials. Polish observed on the flake tools ranged from generic to fully developed, and polish in different stages of development was often observed on a single artifact. The amount of polish observed, in combination with its distribution, texture, and morphology, suggests that the majority of the flake tools from Mussel Beach were not used for prolonged periods of time, and were often discarded before they had reached the point of exhaustion. This is, however, often the case with expedient tools. A single tool might be used to initiate a task, however, before the task is complete several flake tools may have been used and discarded.

Although it was not possible to determine specific contact materials on all of the 308 specimens examined, relationships between such things contact materials, tool types, use-action, and raw material can still be explored on those specimens in which polish type was determined.

I look first at the relationship between contact materials and tool type using a Chi-Square test of independence (Table 6.10). The results indicate that tool type was independent from contact materials (Table 6.11). This suggests that the three flake tool types identified within the Mussel Beach assemblage (i.e., use-modified, retouched, and formally retouched) were not selected for use on specific contact materials. With such high quality raw material, it is more likely that flake size, thickness, and edge angle were more important factors when selecting blanks for use.

In addition to looking at relationships between contact materials and tool type, a Chi-Square test for independence was used to evaluate the relationship between materials worked and use-action (Table 6.12). The results of the Chi-Square were significant, which suggests that use-action and contacts materials were not independent of one another. This result, however, was not surprising as the processing of many raw materials requires tools to be used in only a single or limited range of motion. Activities associated with hide processing, for example, require intensive scraping, while those associated with butchering tend to emphasize cutting or sawing actions. In those instances where a tool is utilized to accomplish a series of tasks, it is often the last task the tool was used for that one is able to interpret.

By combining the microwear evidence for use action and contact materials it is possible to discern, more specifically, the types of activities in which flake tools were used (Figure 6.28). Based on the results of the usewear analysis of the flake tools, it is evident that flake tools were used most frequently used in butchering activities. The cutting and scraping of bone/antler and fresh meat/hide would suggest that flake tools played an important role in the process of butchering of animals and working of their hides. The low frequency of tools used to scrape dry

Table 6.10: Chi-Square Test of Independence between Tool Type and Contact Materials

Tool Type	Bone/Antler	Wood/Woody Plant	Dry/Greased Hide	Fresh Meat/hide	Plant	Totals
Use-modified	39 (37.3)	21 (24.3)	8 (7.8)	29 (27.8)	8 (6.9)	105
Retouched	4 (5.7)	7 (3.5)	1 (1.1)	3 (4.0)	0 (1.0)	15
Formally Retouched	1 (1.0)	0 (.2)	0 (.1)	0 (.3)	0 (.1)	1
Totals	**44**	**28**	**9**	**32**	**8**	**121**

(X^2=7.65. df=8, *P*=.468)

Table 6.11: Results of Chi-Square Test of Independence between Flake Tool Type and Contact Materials

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	7.651[a]	8	.468
Likelihood Ratio	8.166	8	.417
Linear-by-Linear Association	1.306	1	.253
N of Valid Cases	121		
a. 9 cells (60.0%) have expected count less than 5. The minimum expected count is .07.			

Table 6.12: Chi-Square test of Independence between Use-action and Contact Materials

Use-Action	Bone/Antler	Wood/Woody Plant	Dry/Greased Hide	Fresh Meat/Hide	Plant	Totals
Scraping	37 (29.1)	23 (18.5)	6 (6.0)	8 (21.2)	6 (5.3)	80
Cutting	4 (8.7)	3 (5.6)	1 (1.8)	15 (6.3)	1 (1.6)	24
Both	2 (4.4)	0 (2.8)	0 (.9)	9 (3.2)	1 (.8)	12
Graving	0 (.7)	2 (.5)	1 (.1)	0 (.5)	0 (.1)	2
Projection	0 (.7)	0 (.5)	2 (.1)	0 (.5)	0 (.1)	2
Totals	**44**	**28**	**9**	**32**	**8**	**121**

(X2=76.59, df=20, *P*=.000)

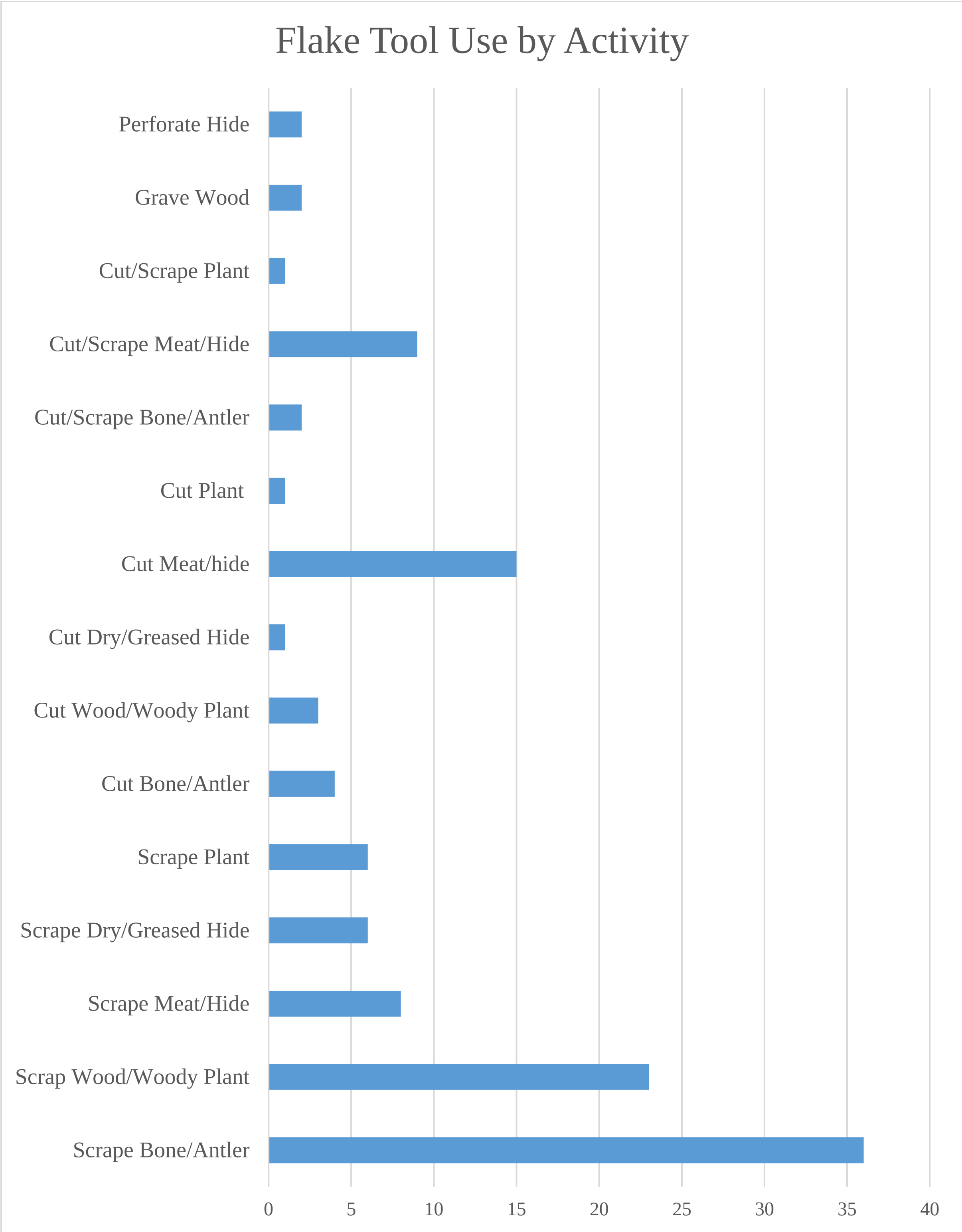


Figure 6.28: Summary of Contact Materials for Flake Tools

or greased hides, would suggest that flake tools were not often used to accomplish this task, or that they were only involved in the initial stages of hide preparation. Tools used to scrape show evidence of both transverse and longitudinal use-actions, indicating that they may have been used in trimming hide for future preparation. Several flake tools also show evidence for having been used to puncture of perforate hide, and this again may have been necessary in the early stages of hide preparation. In addition to butchering activities, flake tools were often used to scrape wood or woody plants, and in some instances flake tools were also used to engrave or groove wood. However, based on the size of the tools, and the degree of polish present, flakes were likely not used extensively, but they were used long enough to develop wear. While not observed in high frequencies, it is evident that flake tools were involved in the processing of silica-rich plant materials. Although polish texture and distribution is similar to that of river cane, it is perhaps premature to make such determinations.

6.6.1 Functional Trends in Flake Tool Use at Mussel Beach

The results presented in the previous section provide an overview of flake tool use at the Mussel Beach site, but do not address flake tool use during each temporal component. In this section, I look specifically at the ways in which flake tools were utilized during each occupational phase and use Chi-Square tests to assess changes in flake tool use over time.

Late Archaic

Flake tools during the Late Archaic I and Late Archaic II were used on a limited range of materials worked. The usewear results revealed that flake tools were primarily involved in the working of bone/antler as well as fresh meat/hide, and were most likely being used in butchering related activities. Wood working was a secondary activity during both the Late Archaic I and II occupations, and does not appear to have been an activity in which flake tools were frequently utilized. During the Late Archaic III, flake tools continue to be used in butchering activities, however based on the tools in which worked materials could be identified, contact with fresh meat/hide does appear to decrease slightly during this component. The working of bone/antler, may be associated with butchering, but it is also probable that the working of bone or antler was associated with tool production. Contact with dry or greased hide is also evident during the Late Archaic III, however it is clear that flake tools were heavily engaged in the processing of hides. The working of wood or a harder woody plant also increases during the Late Archaic III, and there is evidence that flake tools were utilized in plant processing activities.

Looking primarily at the function of flake tools, it is apparent that between the Late Archaic II and III occupations there are changes in site use. Increases in the visibility of wood working activities suggests that there may have been an increase in tool production, shelter constructions, or scaffolding associated with shellfish preparation. The appearance of plant polish on lithic artifacts during the Late Archaic III is also significant, as it is during this occupation that EAC cultigens become incorporated into the subsistence system. Of the artifacts with evidence of plant polish, scraping is the dominant use action, which suggests that these tools were not involved in the harvesting of plants from the environment. It is also unlikely that they were involved in the processing of EAC cultigens or plant food stuffs, as the preparation of EAC plants does not require scraping of any kind in their preparation. While the processing of plant foods cannot be ruled out, it is more probable the scraping of plant materials was associated with material culture production.

Middle Woodland

During the Middle Woodland occupations at Mussel Beach, flake tools continue to be used as butchering tools, as indicated by the presence of distinct bone/antler and hide polishes.

Compared to the Late Archaic I and II occupations, contact with fresh meat/hide and bone/antler decreases slightly. While this might suggest a decrease in butchering activities on site, it could also be the result of other factors, including shorter use times or perhaps sampling by New South Associates. During the Middle Woodland flake tools continue to be engaged in wood working activities and there is evidence again for the processing of silica-rich plants. These activities, however, do not appear to increase from the Late Archaic. In fact, flake tool use during the Middle Woodland occupation is similar to that of the Late Archaic III.

In general, it appears that flake tools were used in similar ways during each temporal component at Mussel Beach. As presented in Chapter 5, the types of flake tools used by occupants during each occupation were similar, with comparable proportions of use-modified, retouched, and formally retouched tools used during each. In order to determine if there were changes in how flake tools were utilized during each occupation I applied the Chi-Square test of independence to two sets of data. First, a Chi-Square test was used to determine if the use-action of flake tools changed significantly between each cultural occupation (Table 6.13). Looking at the functional variables cutting, scraping, graving, perforating, and wedging, the results of the Chi-Square indicate that use actions for flake tools were similar during each occupation (Table 6.14).

Next, a Chi-Square test was used to determine if the working of various contact materials changed significantly between each component (Table 6.15). When the Chi-Square was applied to data that included only tools with identifiable polish, it resulted in a non-significant P-value of .664. This indicates that the contacts materials in which flake tools were used was distributed similarly between each temporal component. However, when a Chi-Square test is applied to the data set that includes non-diagnostic polish, as well as tools that lack polish all together, the

Table 6.13: Results for Test of Independence between Temporal Component and Use-Action

Component	Scraping	Cutting	Both	Graving	Wedging	Projection	Unsure	Totals
LA I	21 (19.0)	4 (4.0)	0 (1.6)	2 (1.0)	0 (.4)	0 (.1)	1 (.2)	28
LA II	36 (34.6)	8 (7.3)	2 (3.0)	1 (1.8)	1 (.7)	3 (3.3)	0 (.4)	51
LA III	75 (80.8)	17 (17.0)	9 (7.0)	4 (4.3)	2 (1.5)	11 (7.7)	0 (.8)	119
MW	77 (74.6)	15 (15.7)	7 (6.4)	4 (3.9)	1 (1.4)	6 (7.1)	0 (.1)	110
Totals	**209**	**44**	**18**	**11**	**4**	**20**	**1**	**308**

(X2=20.65, df=21, *P*=.480)

Table 6.14: Results of Chi-Square Test of Independence between Use-action and Temporal Component

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	20.653[a]	21	.480
Likelihood Ratio	19.246	21	.569
N of Valid Cases	308		
a. 21 cells (65.6%) have expected count less than 5. The minimum expected count is .09.			

Table 6.15: Chi-Square Test for Independence between Temporal Component and Contact Materials (Includes only Identifiable Polish)

Component	Bone/Antler	Wood/Woody Plant	Dry/Greased Hide	Fresh Meat/Hide	Plant	Total
LA I	5 (4.4)	3 (2.8)	0 (.9)	4 (3.2)	0 (.8)	12
LA II	7 (6.9)	4 (4.4)	0 (1.4)	8 (5.0)	0 (1.3)	19
LA III	12 (13.1)	10 (8.3)	3 (2.7)	8 (9.5)	3 (2.4)	36
MW	20 (19.6)	11 (12.5)	6 (4.0)	12 (14.3)	5 (3.6)	54
Total	**44**	**28**	**9**	**32**	**8**	**121**

(X2=9.45, df=12, *P*=.664)

result is a significant P-value of .003 (Table 6.16). The incorporation of the unknown contact materials changes the significance because there were far more unidentified polish types than expected, particularly among the Late Archaic III and Middle Woodland assemblages. As discussed in Chapter 5, polish development is dependent upon several factors, including hardness of materials worked and duration of use. Because the tools examined for this dissertation are considered to be expedient in nature, they often were not used long enough to develop diagnostic polish. Tool use between and polish development does differ between Late Archaic III and Middle Woodland, and while this may be related to an increase in the working of softer contact materials, it could also reflect the intensity of use site.

In Chapter 2, I outlined the propositions on which this dissertation research was based. The propositions state: 1) *the functions of utilized and minimally retouched flake tools changes throughout each temporal occupation at the Mussel Beach Site with a significant increase in plant processing activities during the latter Woodland components;* 2.) *flake implements with evidence of plant wear were used primarily in the processing of plants for the production of perishable material culture, including, but not limited to, split-cane baskets and mats;* 3.) *plant-processing during the Middle Woodland occupation was accomplished by individuals associated with the collection and preparation of shellfish, and may further have been conducted using expedient lithic and shell tool technology;* and finally 4.) *increases in plant-processing activities for perishable material during the Middle Woodland indicates changes in population demographics and an increase in the visibility of women's work.* With respect to the first proposition, the results of the usewear analysis find that this proposition is not fully supported. The functional analysis of the flake tool assemblage from the Mussel Beach site show that flake tools were used during each temporal component to process a variety of contact materials.

Table 6.16: Chi-Square Test of Independence between Component and Contact Materials (Include Non-diagnostic Polish)

Component	Bone/Antler	Wood/Woody Plant	Dry/Greased Hide	Fresh Meat/Hide	Plant	Unknown	Total
LA I	5 (4.0)	3 (2.5)	0 (.8)	4 (2.9)	0 (.7)	16 (17.0)	28
LA II	7 (7.3)	4 (4.6)	0 (1.5)	8 (5.3)	0 (1.3)	32 (30.9)	51
LA III	12 (17.0)	10 (10.8)	3 (3.5)	8 (12.4)	3 (3.1)	83 (72.2)	119
MW	20 (15.7)	11 (10.0)	6 (3.2)	12 (11.4)	5 (2.9)	56 (66.9)	110
Totals	**44**	**28**	**9**	**32**	**8**	**187**	**308**

(X2=38.96, df=18, *P*=.003)

Despite differences in the degree to which contact materials were identified, the results of several Chi-Square tests of independence revealed that there were no significant differences in flake tool use between occupations at Mussel Beach. The analysis of the flake tools concluded that bone/antler were the most frequently identified worked materials, and this was followed by fresh meat and hide, wood, plants, and dry or greased hide. While the results did show that plant processing increased from the Late Archaic to the Middle Woodland, the increase was not statistically significant.

The results of the usewear analysis also made it possible to address the second of the four propositions put forth in Chapter 2. At this time, I conclude that the second proposition is not rejected, although I am reluctant to state it is fully supported. Although the plant polish identified on a sample of the flake tools looked similar to polish observed on the experimentally produced tools, it is difficult to say with any degree of certainty that the polish observed on the archaeological specimens was produced during cane processing activities. As noted in Chapter 3, a variety of plant materials can be used to produce items of material culture, and many different plants are edible. The sample of both experimental tools and archaeological tools with plant polish is simply too small to make any definitive determinations. With that being said, it is also premature to conclude that these tools were not involved in cane processing activities or the production of perishable material culture. The presence of processed carbonized cane fragments from the Late Archaic III and Middle Woodland samples suggests that cane processing did occur and it was likely an important activity taking place at Mussel Beach.

In the next chapter I pull together all of the information presented in previous chapters to address the final propositions and discuss the organization of flake tool technology at Mussel Beach and the possible evidence for gender activities, spaces, and technology. I also compare the results of my analyses and interpretations of the Mussel Beach Site to those provided by Gregory et al. (2011) and Carmdoy (2014), and further evaluate the ways in which changes in tool function reflect shifts in site use, resource exploitation, material culture production by gendered individuals at the Mussel Beach Site.

Chapter 7: A Discussion and Summary of the Organization of Technology and Gendered Tasks at the Mussel Beach Site

In this chapter I will summarize flake tool use and the organization of technology at the Mussel Beach Site based on the information presented throughout this dissertation. By incorporating an Anthropology of Technology approach to the study of technological organization, I also consider how tool function might be used to understand the wider social contexts associated with flake tool use and perishable technologies. By social contexts, I am referring more specifically to the ways in which gendered individuals not only used lithic artifacts at Mussel Beach, but how they organized themselves on the landscape in their pursuit of raw materials for both subsistence and material culture production. My understanding of both the technological organization of expedient tool technology at Mussel Beach and gender, however, is based not only on the results of the lithic analysis, but also incorporates information from the faunal and paleobotanical assemblages, as well as the ethnographic and ethnohistoric records. It should be noted that although I began this dissertation with the intent of engendering the archaeological record at Mussel Beach through the analysis of flake tool technology, I found myself searching in earnest for evidence for the processing and production of split-cane technology. I began focusing more on the production of perishable material culture with an understanding that by discovering evidence of cane processing I could more accurately demonstrate the actions of women in the archaeological record.

For more than four thousand years the site known as Mussel Beach was utilized by Native Americans for the procurement and processing of raw materials. Located on a rich alluvial floodplain along the Tennessee River, the site was extremely rich in natural resources, including several varieties of chert, terrestrial and aquatic fauna, and a range of plant and nut taxa. That the site was continuously revisited throughout the Late Archaic and Woodland periods, testifies to not only the fact that the location provided not only an abundant supply of natural resources, but also that these resources remained stable and predictable enough over time to support both short and long-term habitations. Changes in site use, including the intensity and duration of occupation, resource exploitation and procurement strategies, and land management practices differed between occupations. This may have been in direct response to such things as changes in mobility and residential practices and the increased emphasis on wild plant resources, each of which would have introduced different practical, economic, and social constraints to land use and resource procurement strategies.

I begin this chapter by presenting a summary of the results of the lithic analysis presented in Chapters 5 and 6, and discuss how these results differed from those of New South Associates that are summarized in Chapter 2. I use this new information to further summarize the organization of technology at Mussel Beach and address changes in site activities with regard to lithic reduction activities, as well as subsistence pursuits and material culture production. By combining the results of the archaeological investigations with historical, ethnohistoric, and ethnographic information, I conclude this chapter with a discussion of changes in gender-based activities at the Mussel Beach site.

7.1 The Lithic Assemblage at Mussel Beach

Lithic reduction activities, including both core reduction and tool maintenance, occurred frequently and consistently during each temporal component at the Mussel Beach site. There are differences, however, in the intensity in which core reduction, flake production, and tool manufacture and maintenance occurred during each occupation. As discussed in Chapter 5 and Chapter 6, I was primarily interested in the flake tool technology from the Mussel Beach site, but the processes involved in finding and identifying flake tools required that I examine the lithic assemblage in its entirety. I began this process by first examining the artifacts which had been identified by Gregory et al. as formal, curated, or diagnostic. Of the chipped stone assemblage, these consisted of projectile points, bifaces, drills, scrapers, and several tools which had been identified as flake tools. In addition to the chipped stone tools there were cores and a variety of groundstone implements, including hammerstones, nutting stones, hoes, abraders, a celt, and mano. Items of personal adornment, including chert beads and a gorget were also recovered from Mussel Beach. Each artifact was examined, and in the event that I disagreed with the classification of the tool by type or tradition, it was reclassified. All tool types presented herein reflect the results of my own analyses. By incorporating the results of the flake tool analysis with those of the formal lithic assemblages, the summaries of the lithic assemblages found in each temporal component reported in this chapter differ from those presented in Chapter 4. In the next section I provide a new summary of the lithic tool assemblages by temporal component, and discuss any changes that were made regarding tool classification. This updated summary includes only artifacts in which a temporal component could be identified. Those artifacts missing provenience information are therefore not included. All primary data for the flake tools are available in Appendices A and B and data associated with the non-tool debitage and chipped stone tools are curated electronically at McClung Museum.

7.1.1 Late Archaic I

The lithic assemblage associated with the Late Archaic I temporal component is the smallest of the assemblages. The low artifact counts, however, are primarily the result of sampling. It was noted by Gregory et al. that many of the test units and trenches excavated were not excavated to the depth that Late Archaic I deposits were encountered (2011:639-640). It is highly probably, therefore, that the Late Archaic I cultural component was more extensive than is reported here. Overall, the LA I lithic assemblage is dominated by non-tool debitage produced from locally available raw materials. All raw materials utilized were of a relatively high quality, and thermal alteration did not appear to be necessary to improve flaking qualities or other tool stone properties. Upon examining the formal tool assemblage, it was evident that the majority of the bifacial tools were fragmented, consisting of only three intact projectile points, where the rest were a mix of distal, proximal, and medial fragments. Without a complete specimen, it can be difficult to further classify bifacial artifacts as anything more than a biface. Bifacial tools, as reported here, include primarily the medial and distal end of bifacial tools, as well as other bifacially flaked artifacts which could not be further classified. Artifacts designated as projectile points, in contrast, represent those artifacts with proximal ends which have been shaped for the purpose of hafting. Table 7.1, summarizes the lithic tool assemblage from the Late Archaic I component.

Excluding non-tool debitage and the stone bead, flake tools comprise the largest component of the chipped stone assemblage from the Late Archaic I component. At 62% (n=28), it is evident that lithic reduction activities during this occupation were focused not only on primary core and bifacial reduction, but that there was also an emphasis on core-and-flake technology. The three cores associated with this component include 1 unidirectional and 2 multidirectional cores, which support an emphasis on flake production. As a whole, the lithic artifacts recovered from the Late Archaic I component represent two distinct technological strategies. The first strategy is centered on the manufacturing of formal curated technologies; these are tools which are often considered to be versatile with the ability to perform multiple tasks. Bifacial tools, like projectile points, require higher levels of skill and design, and tend to be maintained and repurposed (Hayden et al. 1996). The other technological strategy centers on

Table 7.1: Updated Summary of Late Archaic I Lithic Artifacts

Lithic Tool Type	**Totals**
Biface	9
Projectile Point/Knife	5
Core	3
Use-modified Flake	25
Retouched Flake	3
Formally Retouched Flake	0
Stone Bead	1
Non-Tool Debitage	1783
Totals	**1829**

the production of expedient flake tools. In terms of flake blank selection, the mean length of the flake tools was 25.81mm, the mean width was 16.66mm, and the mean thickness was 4.06mm. When the compared to the non-tool debitage the blanks selected for use were on average longer and thicker than the non-tool debitage, but were similar in width (Table 7.2).

The flake tools from this occupation are primarily use-modified, were utilized on only a limited range of contact materials, and for the most part are considered to be tools utilized in tasks that required some precision. While no faunal remains were recovered from any of the Late Archaic I deposits, results of the microwear analysis indicated that several of the tools were involved in butchering activities. The lack of retouching and minimal use related wear, suggests that the flake tools were expedient, but situational rather than purely opportunistic. It is likely that raw material availability and quality were known by the sites occupants, and many, if not most of the flake tools, were produced in response to immediate needs. Based on the results of the lithic analyses, it is evident that the Late Archaic I component at Mussel Beach was used for lithic reduction, however the usewear results indicate that the site was also being utilized as a hunting camp with on-site processing, and may also have been used as a rehafting location.

Table 7.2: Comparison of Mean Length, Width, and Thickness for Late Archaic I Flake Tools and Non-tool Debitage (mm)

Flake Type	Length (mm)	Width (mm)	Thickness (mm)
Non-tool Debitage	20.59	16.19	3.61
Flake Tools	25.81	16.66	4.06

Rehafting sites, as defined by Keeley (1982), are those wherein handles, shafts, or foreshafts are replaced. These sites may include evidence of early stage reduction, but also contain wood working tools that were presumably used to manufacture the new haft. The lack of associated features and material culture from this component makes it difficult to speculate further about other types of activities which may have occurred during this particular occupation.

7.1.2 Late Archaic II

The assemblage of lithic artifacts recovered from the Late Archaic II is slightly larger than the Late Archaic I, and consists of a more diverse assemblage of chipped stone and ground stone artifacts. The assemblage overall is dominated by non-tool debitage produced from varieties of locally available chert. While many of the chipped stone bifaces are fragmented, there are a number of complete and proximal fragments which could be identified as temporally diagnostic. Additionally, many of the bifacial tool fragments contain not only intact distal ends, but also include medial portions. In these instances, it was often possible to identify more specific tool types, beyond that a generic biface. With regard to many of the bifacial tools recovered from the Late Archaic II, the component differs from the preceding Late Archaic I in that many of the bifacial tools have been identified as being in various stages of production. Stage bifaces, as defined by Andrefsky (2005), are bifacial artifacts that are characterized as being in one of five stages of completion, depending on the extent of bifacial flaking, edge retouch, or other special treatments. While the categorization of bifaces into stages can be subjective, it is based primarily on tool shape, thickness, and degree of refinement. In many cases, early stage bifaces can function as both tools and bifacial cores. There was no attempt at this time to make these distinctions. Table 7.3 summarizes the lithic tool assemblage from the Late Archaic II component.

With the incorporation of the flake tools and the reclassification of the several bifacial tools, the lithic assemblage associated with the Late Archaic II component changes slightly. The most obvious addition to this assemblage are the 51 flake tools, which comprise 50% of the total lithic assemblage excluding the non-tool debitage. This indicates, again, that lithic reduction activities at Mussel Beach included core-and-flake technology, and that a portion of the core reduction activities centered on the production of blanks for use as tools. Of the 7 cores identified, four were identified as multidirectional, and three were amorphous. Each of these cores were small and were likely discarded after being broken or exhausted. It is possible that several of the early stage bifaces identified also served as cores for flake production. Detaching flakes from multidirectional and amorphous cores, however, requires less platform preparation than bifacial, bipolar, or unidirectional cores. The examination of platforms on the flake tools indicated only minor preparation, suggesting that cores were not being prepared to produce morphologically specific flake blanks. As outlined in Chapter 5, the LA II flake tools were primarily use-modified in a variety of shapes and sizes. A small sample of the flake tools, however, exhibited intentional retouching associated with both prehension and tool shaping. The mean length of the LA II flakes tools measured 19.32mm, the width 15.96mm, and thickness 3.28mm. When compared to the non-tool debitage associated with this temporal component, a pattern emerges wherein flakes selected for use are on average longer, wider, and thicker than

Table 7.3: Updated Summary of Late Archaic II Lithic Artifacts

Lithic Tool Type	**Total**
Abrader	1
Biface	22
Core	7
Drill	3
Perforator	1
Scraper	3
Hammerstone	5
Nutting Stone	1
Projectile Point	8
Use-modified flake	44
Retouched Flake	6
Formally Retouched Flake	1
Non-tool Debitage	5253
Total	**5350**

the non-tool debitage (Table 7.4). This pattern in flake tool selection is also indicated in part for the Late Archaic I occupation above.

In general, the flake tools from this occupation were characterized as being expedient in nature, and likely were not intended to be taken from the site when it was abandoned. The microwear analysis revealed that the flake tools were involved in primarily butchering-related activities, although there is an increase in the processing of wood or woody plants. In addition to the flake tools, I also included a category of tools identified as formal scrapers. Two of the scrapers were classified as side scrapers, and the third appears to have been a biface that was repurposed into an end scraper. Tools with direct evidence for repurposing, however, are not abundant within this occupation. The results of the lithic analysis do not change those presented by Gregory et al. (2011). The abundance of non-tool debitage, cores, and stage bifaces, suggests that Mussel Beach did serve as a lithic reduction and tool manufacturing site during the Late Archaic II. Similarly to the Late Archaic I, lithic reduction strategies were centered on the production of both curated and expedient tools. The expedient flakes, while produced from a

Table 7.4: Comparison of Mean Length, Width, and Thickness between Late Archaic II Non-tool debitage and Flake Tools (mm).

Flake Type	**Length (mm)**	**Width (mm)**	**Thickness (mm)**
Non-tool Debitage	19.32	15.96	3.28
Flake Tools	24.26	17.11	3.78

range of local materials, show little variability in terms of form. The general size of the multidirectional and amorphous cores, and associated debitage, do suggest a size constraint with regard to many of the raw materials available to Mussel Beach occupants. Smaller cores were likely used for core-and-flake technology, and larger cores for bifacial reduction.

Faunal remains recovered from the Late Archaic II component showed evidence for butchering, and the microwear analysis on many of the flake tools confirm these interpretations. The diversity of tools found within this component suggests, however, a more extensive occupation, wherein lithic manufacturing was just one activity taking place. The introduction of specialized tool forms like drills, scrapers, and perforators suggest the addition of more specialized tasks. An increase in wood working activities suggests perhaps the production of wooden tools for rehafting, but may also indicate the processing of woody plant materials. The analysis of the archaeobotanical remains from the Late Archaic II did find carbonized fragments of river cane culm within two separate thermal pits as well as within a storage pit. The analyses of those samples revealed specimens where the hard outer cuticle and inner fibrous materials were present and samples that appeared to lack the hard outer cuticle. While none of the flake tools show definitive evidence of plant polish, it is possible that cane processing for material culture production began as early as the Late Archaic II. River cane, however, is an extremely versatile plant, and can be used in anything from house construction to tool manufacture and even weaponry.

The analysis of the archaeobotantical assemblage by Carmody (2014) suggests that during the Late Archaic II the site served as more than a temporary fall logistical campsite as was inferred by Gregory et al. 2011. Carmody suggests instead that during the Late Archaic II the site may have been revisited multiple times throughout the year for the purpose of collecting wild cultigens, including maygrass, goosefoot, knotweed, and sunflower/sumpweed (Carmody 2014; Gregory et al. 2011). The bulk collection of mast resources, including hickory, walnut, and acorn was also an important activity occurring throughout this occupation. In such a resource rich location, it is not surprising to find that the site saw repeated occupations by small logistical task groups for the purpose of collecting and processing various resources.

7.1.3 Late Archaic III

The lithic assemblage recovered from the Late Archaic III temporal component is the largest assemblage from the Late Archaic, containing a substantial collection of debitage and flaked stone artifacts. The summary of artifacts reported here include those from the Late Archaic III, as well as a small group of lithic artifacts identified by Gregory et al. as Late Archaic/Early Woodland. Projectile point types were used to classify these artifacts within the Late Archaic occupation, rather than the later Woodland components. As with the previous lithic assemblages, the lithic assemblage recovered from the LA III was dominated by non-tool debitage manufactured from locally available raw materials. The assemblage also contained a diversity of tool forms, including drills, stage bifaces, projectile points, and groundstone artifacts. While the assemblage of bifacially flaked tools was highly fragmented, it was possible to identify several projectile point types based on the shape of the proximal end. Distal and medial biface fragments are difficult to identify specifically as projectile points, and are therefore identified herein as bifaces. Table 7.5 provides a summary of the lithic artifacts from the Late

Table 7.5: Summary of Lithic Artifacts from the Late Archaic III Component

Lithic Tool Type	**Totals**
Celt	1
Biface	49
Core	22
Hammerstone	3
Projectile Point/Knife	24
Polished Stone	2
Drill	4
Use-modified Flake	103
Retouched Flake	12
Formally Retouched	4
Non-tool debitage	10,470
Unidentified Tool	1
Totals	**10695**

Archaic III component.

Compared to the summary of lithic artifacts presented in Chapter 4, the updated table varies only slightly, with the exception of the addition of flake tools. Similar to the Late Archaic I and II components, flake tools comprise a much larger component of the chipped stone assemblage than was reported by Gregory et al. (2011). At 53% (n=119), the flake tools make up more than half of the lithic tool assemblage. Flake production for tool use appears to have occurred more frequently during this component, this is based not only the higher frequency of flake tools but also on the large collection of cores recovered from this occupation. While often broken or fragmented, many of the Late Archaic III cores were identified as multidirectional and amorphous, suggesting an emphasis on core-and-flake technology. Two of the cores from this occupation were also identified as being utilized for bipolar reduction and the manufacture microblades or microtools (Figure 7.1). Bipolar cores are often found in locations with small size nodules that are not large enough for traditional percussion techniques, such as the nodules of Knox chert available within the Tennessee River Valley. The flakes resulting from bipolar

Figure 7.1: Small Microblade Core from the Late Archaic III Temporal Component

reduction are too small to be shaped into projectile points or formal bifacial implements, and are instead more amenable for use as unmodified flake tools, or finely retouched flake tools. Blade tool technology in general also requires more skill, as well as a design component that is not associated with flake-and-core technology. The majority of flake tools from the Late Archaic III are, however, relatively small, with a mean length of 24.49mm, mean width of 16.09mm, and mean thickness of 4.42mm. When compared to the non-tool debitage, the flake blanks selected for use were longer and thicker, but they were on average more narrow (Table 7.6).

The Late Archaic III flake tools were primarily use-modified, however there was an increase in the frequency of retouching. A small sample of retouched flake tools show evidence of hafting, while the majority were retouched for the purpose of creating a functionally specific

Table 7.6: Comparison of Mean Length, Width, and Thickness for Late Archaic III Flake Tools and Non-tool Debitage (mm).

Flake Type	Length (mm)	Width (mm)	Thickness (mm)
Non-tool Debitage	20.37	18.67	3.39
Flake Tools	24.49	16.09	4.42

edge. Pointed tools, likely used as perforators and graving implements, increase in frequency, as do concave shaped spokeshaves. Despite an increase in retouching, these flake tools are considered to be expedient, situational type tools that were used for both specialized and generalized tasks. The results of the microwear analysis found that the Late Archaic III flake tools were used on a greater variety of raw materials; however, butchering-related activities werethe most prevalent. Even though Gregory et al. (2011) report a decrease in butchering activities based on the analysis of the faunal assemblage, the microwear results find that on site butchering was still an important activity taking place during the Late Archaic III occupation. Sharp straight-edged flakes were most frequently utilized as butchering tools, as indicated by the presence of both fresh hide and bone polish.

As previously noted, the working of hard materials like bone and antler tends to be overrepresented in the archaeological record, while the working of softer materials like plants can be relatively undetected. While evidence of wood working was evident on the flake tools, there is also evidence for the working of greased or dry hides. With regard to the hide working, flake tools were likely only used in the initial stages of hide processing. The polish is for the most part underdeveloped, and there is only minor edge rounding. It is currently unclear if hides were completely processed on site during the Late Archaic III occupation, as hide processing tools, like side and end scrapers, are absent from the assemblage of lithic artifacts. It is possible that the hides were taken elsewhere for additional processing, or perhaps that the scrapers utilized in such a task were considered to a curated form of technology that were taken from the site to be used elsewhere.

The processing of silica-rich plants is also added to the suite of activities taking place at the Mussel Beach site during the Late Archaic III occupation. Two of the three artifacts on which plant polish was identified were used in a transverse, or scraping motion. The polish in both cases is extremely well developed, occurring along and away from the crest of the working edge. The morphology, texture, and distribution of the polish, and the slight rounding of the working edge, suggests the working of a soft to medium plant. That the polish is relatively well developed also indicates that the tools were used extensively before they were discarded. The third tool identified as having plant polish was used in both longitudinal and transverse directions. This might suggest that the tool was used in both harvesting and processing activities, or perhaps that the processing activities associated with the plant in question required that the plants be cut or trimmed as well as scraped.

Because nearly all of the flake tools examined in this dissertation were recovered from within the screened debitage, it was difficult to address specific spatial relationships between artifacts and activities at Mussel Beach. None of the LA III artifacts were found in direct association with river cane, however plant remains in form of EAC cultigens were recovered from within the same features as artifact 0-675 and 0-142. Whether or not the tools were used directly in the harvesting of processing of these plants is speculative.

Studies of the paleobotanical assemblage from the Late Archaic III occupation show an increase in the harvesting and consumption of plants with edible seeds, particularly maygrass and chenopod, which may indicate the intensification of gardening practices (Carmody 2014). There is also a continued reliance on hickory, and evidence that grapes and red mulberry were utilized (Carmody 2014; Gregory et al. 2011). Studies suggest that an emphasis in food production associated with horticulture, and later agriculture, increased the demands on women's labor and productivity within many societies (Brumfiel 2006). An increase in productivity should also bring an increase in visibility at the microscale. With respect to the use of lithic technology, the harvesting and preparation of these plant resources do not directly require plant materials to be scraped or extensively processed before they are edible. The small grains of maygrass and chenopod were likely harvested by hand-picking or by beating, but once harvested they would have required parching, threshing, or winnowing (Scarry 2008).

Winnowing, a task frequently associated with the processing of grains and seeds, is often accomplished using a woven basket or specialized winnowing tray. Winnowing baskets woven from river cane were historically used in the preparation of maize at contact, but this technology is likely to have more ancestral roots (Lowie 1910:285). Recovered from within a Late Archaic III storage pit were five carbonized fragments of river cane culm. The analyses of the charred culm fragments revealed that they had been stripped of their outer cuticle, and were perhaps remnants of the discarded inner fibrous materials. It is probable that river cane was processed on site for the manufacturing of such items as baskets or mats. The production of most baskets requires anywhere from 10 to 20 culms, and the refuse associated with their preparation would have been great. Given the low density of cane recovered from this occupation, it may be that few culms were processed or there was simply poor preservation during this component.

Features associated with the Late Archaic III, including post holes, a cultural surface, thermal and storage pits, as well as a refuse midden suggest that the site may have seen more than just short-term logistical occupations, but instead saw both short and long-term habitations

(Gregory et al. 2011). The construction of a shelter would have required the additional processing of raw materials, including wood and perhaps cane. Historically, river cane was used in house construction, and cane was processed into matting that was observed covering walls, benches, and beds (Hill 1997). If the site saw a long-term habitation, it is possible that cane was processed for the production of matting or perhaps other construction related activities.

The results of the lithic analysis for the Late Archaic III do not necessarily change the interpretations of this component that were presented by Gregory et al. (2011). During the LA III lithic reduction and perhaps rehafting continued to be an important site activity, and as evidence indicates, there were multiple reduction trajectories (Gregory et al. 2011:649). There was, however, an emphasis on the production of flake blanks for use as tools and evidence to indicate a microblade or microtool technology. While these expedient tool represent a generalized form of technology, the microwear results indicate that they were likely involved a variety of more specialized tasks. In their interpretation of the Late Archaic III occupation, Gregory et al. (2011) do state that the site may have been used for at least one long-term settlement, but likely saw multiple short term occupations. Many settlement models suggest that an increased use of expedient flake tools and, by extension, cores can be a sign of an increase in sedentism (Parry and Kelly 1987). Although the relationship between technology and mobility is often complex, depending upon a number of different variables, it is evident that the Mussel Beach site was perceived as being a place of important economic value (Carmody 2014).

7.1.4 Middle Woodland

The Middle Woodland lithic assemblage is relatively small compared to the Late Archaic III stone tool assemblage, but it represents the most diverse of the lithic assemblages at the Mussel Beach site. The tools were derived from two discrete occupations that were identified through the clustering of radiocarbon dates (Gregory et al. 2011). The earlier cluster of dates contain shell processing middens, while the latter cluster contains the evidence of structures and features which suggest a much more substantial habitation. Artifacts included in this summary are also those which had been placed by Gregory et al. into non-discrete temporal components. These include designations such was Middle Woodland/Late Archaic, Late Archaic/Early Woodland/Middle Woodland, and Middle Woodland/Late Archaic. The decision to include these artifacts with the Middle Woodland component was based on projectile point types. The summary of the lithic tool assemblage provided in this section represent a general overview of lithic tool use during the entire Middle Woodland occupation.

Overall, the lithic assemblage from the Middle Woodland is dominated by non-tool debitage manufactured from locally available raw materials. The assemblage contained a variety of complete and fragmented tool forms, including projectile points, non-hafted stage bifaces, drills, perforators, and a small sample of retouched bifaces. In addition to the chipped stone artifacts were an assortment of groundstone artifacts, including hammerstones, abraders, nutting stones, manos, and hoes. Table 7.7 provides a summary of the lithic artifacts from the Middle Woodland occupations.

The summary of lithic artifacts for the Middle Woodland is rather different than Table 4.20 presented in Chapter 4. The primary differences include the numbers of bifaces, projectile points, cores, and flake tools reported in each table. Differences with regard to the bifacial tools and projectile points are primarily due to my designation of distal, medial, and lateral bifacial fragments as generic bifaces rather than PP/k's. Once again, only bifacial tools with diagnostic proximal ends were characterized as projectile points. The increase in recorded bifacial tools is also likely the result of misidentifications during the previous analyses. Biface tools, were, for

Table 7.7: Updated Summary of Lithic Artifacts from the Middle Woodland Temporal Component

Lithic Tool Types	**Total**
Abrader	2
Bifce	51
Core	26
Drill	1
Perforator	2
Retouched Biface	2
Gorget	1
Hammerstone	6
Hoe	5
Mano	2
Nutting Stone	1
Plummet Stone	1
Projectile Point/Knife	18
Scraper	2
Unidentified	1
Use-modified Flake	90
Retouched Flake	18
Formally Retouched Flake	2
Non-tool Debitage	3,995
Totals	**4,226**

example, found among non-tool debitage and angular shatter. The number of core tools also differs considerably from the previous summary, as a number of small cores and core fragments were also recovered from within the non-tool debitage assemblages. The cores were primarily amorphous and multidirectional, however two showed evidence of bipolar reduction and the production of microblades.

Perhaps the greatest difference in the lithic assemblages is the frequency of flake tools recovered from the Middle Woodland. When debitage is not factored in, flake tools make up 45% (n=103) of the lithic artifact assemblage. While this is slightly lower in comparison to the Late Archaic occupations, the frequency of flake tools, coupled with the frequency of cores, suggests strongly that there was an emphasis on core-and-flake technology. As reported within the previous occupations, the flake blanks selected for use during the Middle Woodland were relatively small, with a mean length of 21.99m, width of 16.76mm, and thickness of 4.68mm. On average, the flank blanks were again longer, thicker, and wider than the non-tool debitage (Table 7.8)

Use-modified flakes dominate the Middle Woodland flake tool assemblage, however there is an increase in retouching associated with flake tool technology. Twenty of the flake tools show evidence of retouching. The purpose of the retouching varies from hafting to prehension, as well as the intentional shaping of the tool's edge to produce a specific form. With respect to tool type, the majority of the retouched flakes were shaped into points, which suggests that many were used as perforators, drills, or gravers. Two of the Middle Woodland flake tools which exhibited retouching were characterized as formally retouched. One of the tools appears to have functioned as perforator and the other a scraper. The flake tool scraper represents one of the only two formal scrapers recovered from this temporal component.

The results of the microwear analysis of the Middle Woodland flake tools found that the tools were used in a variety of ways on many different types of raw materials. Compared to the preceding temporal components, there is a slight decrease in evidence for butchering activities during the Middle Woodland. With the largest faunal assemblage of all occupations it is not likely that there was a decrease in hunting during the Middle Woodland. Instead, it may be that many of the butchering activities that took place during these occupations were occurring outside the area of habitation and outside of the area of excavation. Tools that were found within the area of excavation with evidence of bone or antler polish may indicate later stage butchering activities, or the manufacture of bone and antler tools. I would suspect that during the Middle

Table 7.8: Comparison of Mean Length, Width, and Thickness between Flake Tools and Non-tool Debitage from the Middle Woodland (mm)

Flake Type	Length (mm)	Width (mm)	Thickness (mm)
Non-tool Debitage	18.56	16.38	3.3
Flake Tool	21.99	16.76	4.68

Woodland component that it is a combination of both.

Compared to the Late Archaic III, there does appear to be an increase in the processing of dry hides during the Middle Woodland. Processing activities with the flake tools, however, was likely minimal. The polish on the tools is primarily in the intermediate stages of develop and the tools do not exhibit polish formation or distribution that is characteristic of intensive hide processing. Formal scrapers are often found to have been used for hide processing. Upon examination, however, the flake tool scraper exhibited evidence of bone polish rather than hide. It is possible that the tool was recycled or repurposed after hide processing was complete, but there is currently no evidence to support this hypothesis. The second of the formal scrapers was not examined under high-power microscopy, it was examined under low-power magnification. The edge damage, in the form of microfractures, were more consistent with the scraping of hard raw materials than a soft and pliable material like hide. It is again possible that if hide processing was a fairly common activity that the formal tools like scrapers were transported from the site after discard. It is also possible that lithic artifacts were not utilized in hide processing during this occupation. As noted in Chapter 4, the Middle Woodland component at Mussel Beach contains large and diverse assemblage of modified shells. Experiments with shell tools have found that they are effective implements for processing hides (Fujita and Melgar 2014) as well as a variety of other raw materials.

Wood working activities were also documented on the flake tools from the Middle Woodland occupations. All of the wood working tools were used in a scraping motion, and one implement was retouched into a spokeshave. Spokeshaves are often used to shape or smooth wooden rods or sticks for use as spears shafts, tools, or arrows, a technology introduced into the Southeast during the Woodland period. The wood polish identified on the Middle Woodland tools tended to be in the intermediate stages of development, which made it difficult to fully discern between wood as a contact material and woody type plant. Polish interpreted as plant was identified on five flake tools. The artifacts, which were used in both scraping and cutting motions, show signs of edge rounding indicative of a soft to medium plant material. Although the polish was not as developed as observed on the Late Archaic III tools, there was similarity in polish morphology and distribution to several of the flake tools used in the river cane processing experiments. The peeling of river cane, a process necessary to remove the inner fibrous material from the culm, resulted in the formation of a bright, but slightly pitted polish away from the working edge within rounding crests of flake scars. Two of the Middle Woodland artifacts exhibit similar patterns and it is possible that they were used to peel and perhaps also scrape river cane.

The processing of river cane for the purpose of basketry of matting is unquestionable during the Middle Woodland component. Carbonized culm fragments were recovered from within 10 different contexts, including five cultural features. The features included two shell-processing middens, a refuse midden, an earth oven, and a thermal pit. Of the total sample of carbonized culm fragments recovered from the Middle Woodland, the culms occurred most frequently in shell-processing middens and associated midden areas. The cane fragments were primarily identified as either remnants of the inner fibers or remnants of the exterior cuticle. A small sample of culms do appear to be intact, which suggests that they were discarded before the fibrous material was removed. There is good evidence to suggest that flake tools were utilized to process at least some of the river cane at the Mussel Beach site, and moreover that this process often occurred in concert with shell-processing activities. Of the five artifacts in which plant polish was identified, three were found within shell midden contexts. Artifact 0-125 was associated with Feature 340, a shell-processing midden dating to the earlier of the Middle Woodland components. This feature, the largest of the shell-processing middens identified at the Mussel Beach site, was radiocarbon dated to 1,570–1,810 B.P. (Gregory et al. 2014:195). Artifacts 0-474 and 0-231 were recovered from within Feature 350, the latest of the five shell-processing middens associated with the Middle Woodland (ca. 1,340–1,730 B.P.). This is also the only shell processing midden associated with the later Middle Woodland occupation. The lack of well-developed plant polish on the Mussel Beach specimens may indicate, however, that flake tools were not the only types of tools utilized in the processing of cane at Mussel Beach.

The location of the carbonized culm fragments within and around the shell-processing middens suggests instead that shell tools may have played a much larger role in cane processing than lithics. The shell tools come in a variety of shapes and sizes, and the sharp working edge would have been effective for peeling or scraping cane culms. Further supporting this are several references to the use of shell tools in processing of cane in both enthnographic and ethnohistoric accounts. Based on the association between the carbonized cane fragments and shell-processing middens, I cannot reject proposition 3, which states that: *plant-processing during the Middle Woodland occupation was accomplished by individuals associated with the collection and preparation of shellfish, and may further have been conducted using expedient lithic and shell tool technologies.* The use of shell-tools may help to explain why so few lithic artifacts at Mussel Beach contain plant polish.

Plant processing activities during the Middle Woodland occupation, while possibly associated with the production of perishable technologies, could also have been related to the harvesting of plant materials for subsistence purposes. The Middle Woodland components contains the largest and most diverse paleobotanical assemblage at the site (Carmody 2014; Gregory et al. 2011). The density and diversity of plant remains suggest an increase in use of edible seeds, herbs, grasses, and fruits, as well as mast resources compared to the previous Late Archaic III component. The increase in edible seed exploitation is believed to represent intensive gardening practices during this occupation. The introduction of sandstone hoes into the lithic assemblage supports an intensification of gardening practices. Successful garden economies would have required an increased emphasis on landscape management, including the clearing of land for new garden plots, crop tending, and crop harvesting (Claassen 2002:227). Cultigens including as maygrass, sunflower, knotweed, and little barley are found to be important components of the Middle Woodland subsistence systems. In addition to these cultigens, a domesticated form of chenopodium was recovered from within the paleobotanical samples. It has been suggested that these plants were cultivated on site during the Middle Woodland in small garden plots (Carmody 2014; Gergory et al. 2011). While most of the these plants can be harvested by hand or through beating, sunflower stems may be cut as part of the harvesting process (Scarry 2008).

With this increase in plant consumption, it likely that plant processing equipment in the form of baskets or winnowing mats, would have increased in use during this period in time. Baskets and mats manufactured from perishable materials like cane, while durable, would have become worn and damaged over time requiring repairs or replacement. The manufacture of baskets or mats would therefore have been closely intertwined with horticultural activities. The significant increase in shellfish consumption should also not be overlooked during the Middle Woodland occupation. Shellfish collection, as with plant harvesting and processing, would have required baskets, bags, or containers and thus the demand for these items would have increased as individuals intensified their collection of these resources.

The analysis of the Middle Woodland lithic assemblage did not necessarily change interpretations of the Middle Woodland occupations presented by Gregory et al. (2011). The results showed primarily a larger assemblage of flake tools and a greater concentration of core-and-flake technologies. The usewear results support evidence for butchering related activities, but identify activities like hide processing and plant working. As previously mentioned, features and radiocarbon dates associated with the Middle Woodland show two distinct cultural occupations. The earlier occupation consisted primarily of shell-processing middens, and mostly likely reflects short term logistical occupations wherein shellfishing was one of the most visible activities taking place. The presence of carbonized culm fragments within the middens and midden areas suggests that cane processing was also occurring alongside shellfishing during these occupations. While the nature of the occupation may have been short-term, the site has proven to be an important logistical plant and shell-processing location. The later of the occupations contains multiple cultural features and evidence of at least two structures. The analysis of plant seasonality by Carmody (2014) supports a long-term habitation at the site, one wherein the occupants were heavily engaged in horticultural activities. Carmody argues further that garden economies, like the one represented at Mussel Beach, typify logistical plant processing sites that likely set the stage for later domestication. Finally, Carmody addresses the social and cultural significance of gardening activities and furthermore credits women with maintaining and managing garden plots (2014:379).

7.2 Gendered Activities at the Mussel Beach Site

To engender the archaeological record it is necessary to explore the ways in which individuals in the past would have produced and used material culture in various social and economic environments. In the Southeast, lithic artifacts represent one of the most abundant tool forms to be recovered, and as such they have been extensively studied. Across time and space, stone tools exhibit considerable morphological and technological diversity and their production and use was predicated on a range of environmental, economic, and social conditions. Ethnographic accounts find that in many cultures, both men and women were actively engaged in lithic reduction and use activities.

While ethnographic accounts provide contexts of tool use that often serve as useful analogies, there are challenges associated with engendering tools in the past. One of the greatest challenges is bridging the gap between tool function and tool user. Within any cultural system, all artifacts have the potential to be gender specific or gender inclusive, but the ability to make these distinctions archaeologically may be difficult, or even impossible. Although the functional analysis of lithic artifacts allows archaeologists to infer aspects of tool function, with respect to the individual who made or used that tool, there is limited information. Discerning gender roles or relations should therefore not be based strictly on assigning gender attributions to specific artifacts, but rather should consider more broadly the contexts in which gendered individuals would have used certain forms of material culture. Task attributions, instead, consider how artifacts are used by individuals in a range of activities. Men and women would have made and used tools for different reasons, and the tasks in which they were engaged were more often than not differentiated along lines of gender, age, or social status. Because individuals divide work in such a way, we can focus more attention on the task to understand gendered work and divisions of labor. At the Mussel Beach site, the challenge therefore became identifying material correlates for women's work, and using appropriate ethnographic and ethnohistoric accounts to support a gendered interpretation of the archaeological record.

The cultural landscape at the Mussel Beach site was populated by various groups of people throughout the more than four thousand years the site was occupied. As a location rich in predictable and sustainable natural resources, Mussel Beach has been regarded as a place of great economic importance. The diversity of natural resources likely made the site attractive to both men and women in their pursuit of resources for subsistence and material culture production. There is little doubt that both men and women visited the Mussel Beach site during short-term logistical forays and as part of more substantial habitations. Their exploitation of the environment and available resource at Mussel Beach was based on pursuit of different resources, and although this may represent a form of gender independence, it is likely that all economic and subsistence activities were complementary, serving the entire community. While it is difficult to know how men and women interacted with one another, I believe that it is possible to conceptualize how gendered individuals interacted with, and manipulated their environment during each temporal component. In the following section I look at the Mussel Beach site from a gendered perspective.

7.2.1 Late Archaic

The earliest of the cultural occupations at Mussel Beach, the Late Archaic I, is perhaps the most difficult to discuss from a gendered perspective. The archaeological evidence for this occupation, while notably incomplete, supports a short-term logistical hunting and lithic reduction camp. To suggest that men and perhaps young boys were the primary site occupants is not unreasonable. Men within mobile hunting and gathering cultures are often associated with hunting and lithic reduction activities, although the participation of women has been documented. While I risk perpetuating androcentric perceptions of past human activity, it is difficult in this context to make an argument for the presence of women or their participation in these activities. Evidence for tasks in which women are traditionally associated are absent from the archaeological record. However, because this component was not fully excavated it is difficult to predict just how extensively the location was used and by whom it was used.

The Late Archaic II and III components offer a slightly more complete picture of site activities and demographics than the preceding occupation. The results of the analyses of the faunal and paleobotanical assemblages find that during the Late Archaic II, the Mussel Beach site was occupied nearly year round in at least some capacity. In the fall, the site was visited by small logistical groups for the purpose of hunting, lithic retooling and rehafting. Among the butchered animals were white-tailed deer, birds, and reptiles which were unidentifiable by taxa. In the late spring and summer months, there is evidence for the exploitation of a variety of plant resources primarily for subsistence, or perhaps medicinal purposes. While all of the occupations associated with this temporal component appear to have been primarily short-term and logistical, it is reasonable to suspect that men and women were exploiting the local environment differently and perhaps at different times.

In the fall and winter months Mussel Beach was most likely visited by small male hunting parties whose primary goals were to hunt and exploit local lithic raw materials. In later spring and summer months, it is reasonable that the small task groups visiting Mussel Beach were composed primarily of women and perhaps children. Local cultigens, including chenopod and knotweed, were collected in bulk from stands that may have been tended and managed during seasonal visits. Halperin (1980) maintains that the degree to which men and women were involved in the direct procurement of resources tended to vary seasonally among many hunter-gatherer societies. Women's association with cultivated and domesticated plants is well documented, and is rarely debated among scholars. As outlined in Chapter 2, many scholars not only believe that gendered division of labor increased with the establishment of farming economies, but that women would have been directly responsible for farming activities and the production of associated material culture (Bar-Yosef and Meadow 1995; Frtiz 1999; Peterson 2007;Watson and Kennedy 1991). At the Mussel Beach site, men and women were most likely were involved in separate, but complementary, foraging practices throughout the year. Their exploitation of the environment and manipulation of natural resources may reflect gendered divisions of labor and activities that contributed to the ongoing success of the community (Gero and Scattolin 2002:162).

For the most part, the Late Archaic III sees an intensification of site use, wherein the activities of those occupying the site become much more visible throughout the year. Small, gender-specific task groups were probably still visiting the site for short-term collecting and harvesting events, but the scale of these events increase during this component. A winter habitation at the site likely meant the presence of one or more small family units. Of importance during this occupation is the continual tending and managing of the wild cultigens. Women's ongoing manipulation of the environment would have encouraged plant growth and helped to establish the productive garden plot associated with the later Middle Woodland component. The introduction of plant working tools during the Late Archaic III occupation suggests an emphasis on gardening practices, and this in turn likely required the production of additional forms plant processing equipment. Women's production would not doubt have extended beyond the garden, as the demand for their labor increased. Men's production, as well, would have extended beyond the hunting grounds during longer habitations. Household divisions of labor, even among semi-sedentary populations, were likely divided along lines of gender and age. Food-preparing labor, as well as material culture production, tends to be differentiated and regularized (Gero and Scattolin 2002:169). During longer habitations there is the potential, however, for more overlap in tasks between men and women. Fish (2000:176) has suggested that there are many contexts in which men and women would have shared responsibilities associated with the different stages in the production and use of managed plants. Such overlap may also have occurred with various hunting pursuits, as women were just as likely to have participated directly, or indirectly in hunts, or the procurement of small game and aquatic resources (Brumbach and Jarvenpa 2007).

7.2.2 Middle Woodland

Perhaps the most complex picture of site activities and demographics come from the Middle Woodland. The range of activities taking place during the series of occupations associated with this component help paint a picture of site that served as place of gathering, processing, and the production of various forms of material culture. During each of the occupations associated with the Middle Woodland, the landscape at Mussel Beach was exploited and raw materials transformed. The earliest of the Middle Woodland occupations focused primarily on the collection and processing of both shellfish and river cane, two activities in which women have been identified as being primarily responsible. Among the vast majority of ethnographically and historically known shellfishing societies, the collection and processing of shellfish is veiwed as marginal in comparison to other types of social and economic pursuits, but this partly because of the association with women and children. Ethnographic accounts document women as the primary collectors and processors of shellfish (May 1982; Meehan1975;

Murdock and Provost 1973; Waselkov 1987). Shellfish collection is recorded as taking place at temporary camps that are frequented by dozens of women and children at different times throughout the year (Meehan 1975; Moss 1993). Cross-cultural studies suggest that shellfish collection assumed various levels of importance in different prehistoric economies, but in general shellfish collection is considered to be an efficient and productive subsistence pursuit, and in some contexts, it may also have been an optimal nutritional strategy (Erlandson 1988). Halperin (1980) found that through shellfishing activities women within many coastally adapted societies were able to contribute a substantial amount of protein to the diet.

Even if shellfish played a minor dietary role, the shell may have been viewed as a desirable raw material in certain contexts. Understanding the role that shell tools played within the larger social/economic system depends heavily on understanding the specific contexts in which shell entered and left the technological system. For example, in contexts such as Mussel Beach, where shell tools are recovered from within middens, gender may have been the primary variable structuring their production. The use of shell tools at Mussel Beach, while reflecting an economic use of an abundant and predictable raw material, is believed to more importantly reflect of the provisioning of other raw materials, specifically river cane, by women. Utilizing shell as a tool source instead of, or in addition to, lithic raw materials may also reflect the social and symbolic roles of shells within the society (Claassen 1991; Moss 1993). Lithic production activities, while minimal in the context of shell-processing, does suggest that some lithic reduction was occurring during these earlier logistical occupations. The extent to which women participated directly in lithic reduction is difficult to predict. However, the presence of lithic artifacts with plant polish within a shell-processing features, does strongly suggest overlap between plant processing activities and shellfishing at Mussel Beach.

In fact, I would suggest that there is little doubt that cane processing occurred in concert with shellfishing during the earliest Middle Woodland occupation. The extent to which shell tools, however, played in this process is currently unclear, however there is reason to suspect that they were directly involved in at least some of the cane processing occurring at the site. While recorded as being physically demanding, the harvesting and processing of river cane for perishable technology has been the primary responsibility of women within many Southeastern cultures. In just a few hours of work, or perhaps a few days at the most, women could easily have processed dozen of culms into thin pliable weaving splits. The discarded remnants of culm interior fibers and unused culm portions, appear to have been swept up or deposited within and around the shell middens. The finely curled ribbon of scraped fibers would also have made excellent kindling, and evidence suggests that these remnants were burned on site.   The earliest of the Middle Woodland components most likely was visited by groups of logistically organized women, whose goals centered on the foraging of economically productive resources and the collection and processing of material resources which contributed to various economic and subsistence pursuits. Site provisioning during this occupation also reflects an intimate knowledge of the local landscape as well as the availability, predictability, and materiality, of the site's natural resources.

The later of the Middle Woodland components reflects the most intensive and perhaps most diverse occupation of the Mussel Beach site, as it is during this component that the occupants appear to use the location for a seasonal, long-term habitation. The construction of more than one substantial buildings represents a new level of site investment that is often seen among groups transitioning from foraging to food production (Ehenberg 1989). The site's inhabitants were engaged a variety of activities, including flintknapping, butchering, and hide working. Usewear results suggest the working of wood and bone or antler, perhaps for the purpose of tool manufacture. Garden plots, with domesticated species of chenopod, were being managed on site, and mast and seed resources were processed and stored for immediate and future consumption. Although not as intense as the earlier occupation, there is a continued emphasis on shellfish collection.

The range of activities and cultural features associated with this occupation reflect the presence of one or more family units consisting of men, women, and children, all actively engaged in different levels of food and material culture production. As noted during the Late Archaic III occupation, labor and production during longer habitations would have been divided along lines of gender and age, although there is the potential for shared and communal activities on both a daily and seasonal basis. Food processing and material culture production would have involved several members of the community, and the manufacture and maintenance of tools and associated features. Men and women would have shared some responsibilities, while also relying on divisions of labor and production, as well each other's knowledge of the landscape and environment, to maintain the success of their community.

At this point, I have addressed three of the four positions on which this dissertation research was based. The final proposition stated that: *increases in plant-processing activities for perishable material culture during the Middle Woodland component demonstrates changes in population demographics and division of labor by gender*. With regards to the production of perishable material culture, it is evident that during the Middle Woodland occupation river cane was being processed on site. The manner in which the cane was processed, suggests strongly that the culms were being prepared into weaving splits. The locations in which the carbonized fragments were found also suggest cane preparation was occurring in concert with shellfish collection and processing activities. I have attempted in this dissertation to demonstrate, through ethnographic and historic accounts, the deep rooted association between women and split-cane technology in Southeast, as well as the cross-cultural relationship between women and shellfishing. It is not implausible to extend these relationship into prehistory, and to make assumptions regarding gendered activities in the archaeological record. Although some may disagree with these interpretations, I believe that this final proposition is fully supported. It is likely that Mussel Beach was visited by both men and women throughout its entire occupational history, but as site use intensified the distinctive activities of men and women became more differentiated and more visible in the archaeological record.

Chapter 8: Concluding Remarks

The Mussel Beach site was, in all a respects, an important location for men and women throughout prehistory. Although valued for different reasons, the site provided a plethora of natural resources for both food production and material culture manufacturing. The resources proved not only to be predictable and relatively stable, but the environment itself was productive enough to sustain short and long term occupations. Having been occupied in some capacity for more than four thousand years, the Mussel Beach site was evidently considered to be a place of social and economic importance. It was occupied during a time of significant cultural and technological changes in the Southeast, and the ways in which the site was used reflected shifts in subsistence and mobility strategies, as well as changes in population demographics.

One of the initial goals of this dissertation was to explore gender at Mussel Beach through changes in material culture, specifically expedient flake tools. I chose to focus my attention on flake tool technology for several reasons. First, and perhaps most important, it was suggested that women within hunting and gathering societies would have been primarily associated with flake tool technology (Gero 1991). This assumption was based on ethnographic observations among contemporary stone using cultures in Africa, Australia, and New Guinea (Gero 1991; Bird 1993; Weedman 2008; 2010). The ethnographic accounts provided compelling evidence for women's association with this technology, but few attempts had been made to test this association archaeologically (see Close 2006; Hurcombe 2008). Sassaman (1992) even suggested that flake tools would not be specific enough, with respect to function and the sexual division of labor, to test ideas about gender or gender relations in the archaeological record. I challenged Sassaman's argument, and stated definitively that the examination of the flake tools from Mussel Beach would test this assumption.

It was perhaps naïve, however, to assume that something as complex and historically and culturally contingent as gender could be understood through the analysis of a single form of technology. Lithic artifacts, particularly expedient flake tools, were more likely to have been a shared form technology, rather than a technology associated specifically with women. Holdaway and Douglas (2012) show that debitage and flaking debris often served as potential caches for all tools users. Unmodified flakes can vary in size and shape, and could have been suitable for the completion of a wide range of tasks. Tool selection, therefore, would have been predicated not on the gender of the individuals, but rather on the nature and intensity of the task to be completed (Holdaway and Douglas 2012:107). With that being said, information gathered from the study of expedient flake tools can in fact be useful in testing ideas about gender and division of labor, if that information is used in combination with multiple lines of evidence.

In order to demonstrate that flake tools were used by women, it was necessary to consider the contexts in which women, and men, would have used flake tool technology within specific archaeological settings. An extensive review of ethnographic and ethnohistoric accounts found a definite and deeply rooted associated between women, plants, and perishable material culture among hunter-gatherers (Murdock 1937; Murdock and Provost 1973; Owen 2005). Ethnographic accounts of the tools used for procuring and processing plant materials, however are rare, and those accounts which do note tool use often reference the use of modern technology. Among the Nunivak Eskimo, women were observed using knives to harvest grasses and other fibrous plants, and using the same knives as scrapers to process plants and break down fibrous materials (Lantis 1984). Throughout North America, women were observed using knives to process plants for basketry, and this association is cross-cultural. While not considered to be universal, it was well established in the Southeast at the time of contact (see Chapter 3). Prior to the introduction of modern technology within native Southeastern societies, stone tools would have fulfilled the roles of knives and scrapers in the harvesting and processing of plant materials, river cane in particular.

While river cane was initially reported as being found at the Mussel Beach site, previous analyses by New South Associates did not specifically address cane use for perishable technologies. My analysis of the carbonized cane fragments revealed culms which had been processed, meaning that the outer waxy cuticle had been intentionally separated from the inner fibrous layers. This observation may not have been made had I not directly observed the processing of river cane during the experimental ethnoarchaeological component of this dissertation. These observations have proved significant because they demonstrate that in the absence of perishable artifacts, it may be possible to identify or infer their production through the refuse left behind. The functional analysis of the flake tools from Mussel Beach also proved to be integral in understanding changes in site use, particularly with respect to plant processing activities. Although the working of plants was not observed as frequently as was expected, it does become visible archaeologically within the Late Archaic III when carbonized culm fragments were also recovered.

The experimental lithic collection created during the cane processing experiments effectively demonstrated that cane processing could be accomplished using simple, non-retouched flakes, and moreover, that the different stages in the preparation of weaving splits produces differential wear patterns. It is recognized that tools other than flakes could have been used the process river cane; however, the sharp working edge of flakes is very similar to the preferred modern processing tools. As noted previously, there is the possibility that shell tools were also utilized in the processing of river cane. Similarities were observed, however, between the wear on two flake tools recovered from the Middle Woodland component and the wear produced during the experimental program. There were, for example, similarities in the location and distribution of polish on the working edge of the flake tools. The polish itself, while similar, was often not fully developed. In general, the polish that resulted from the cane processing experiments, differed with respect to stages of development and overall texture and morphology. Cane polish in its early stages of development is pitted and rough in texture, and often looks more like wood than a silica-rich plant. As it develops, the polish spreads and gradually transitions from rough to a more smooth and fluid texture. It continues to exhibit pitting, but overall it is extremely bright and highly reflective. The polish observed from cane working does not seem to exhibit the same characteristics associated with sickle gloss. River cane is, however, a woody plant, whose culms can be extremely hard and brittle depending upon the moisture content. It is possible that polish previously identified as wood or woody, was produced as the result of working river cane, but there may be no way to make such differentiations on archaeological specimens.

Split-cane baskets have been recovered within archaeological contexts throughout the Southeast typically in dry caves and rockshelters. As complete specimens, baskets and matting offer an opportunity to study technological aspects of split-cane production, including weaving techniques, patterns, and decorative motifs (Horton 2010). Such studies demonstrate continuity, as well as change, in basketry construction and demonstrate unequivocally the importance of this technology among Southeastern cultures. Yet aspects of this technology that have not been examined archaeologically, especially the tools necessary in their construction. Being able to identify tools and even refuse associated with the production of split-cane technology is important if we are to understand where and when this technology originated, and the importance that it had among those who produced and used it.

Split-cane technology today is a respected and valued art form that is making a resurgence within many Southeastern communities. Shawna Morton Cain and Roger Cain, as well as the many other traditional weavers within Southeastern tribal communities, demonstrate that split-cane technology has quietly persisted in this region. Shawna Morton Cain writes, that "A basket is a living…..a traditional art form that has prevailed all the trials and tribulations of the Cherokee people….it represents tradition and pride in those who came before" (296:2017). It is a form of technology that was once integrated into every aspect of people's lives, and it was, and still is to some respect, a technology associated with female production and labor.

While studies of gender in the archaeological record vary in North America, there has been a marked increase in gendered studies in North America within the last few decades. The results presented in this dissertation have the potential to influence future archaeological studies because they present a gendered past obtained from a multidisciplinary perspective and a holistic approach. The reliance on singular lines of evidence is not sufficient if we are to create an archaeological past populated by gendered individuals. By engendering the archaeological record we are humanizing the archaeological record, bringing into focus the men, women, and children who made, used, and discarded materials on the landscape in their daily interactions with one another and the environment. Such studies also have the potential to bring into focus aspects of pastlifeways that may otherwise have been hidden in plain sight.

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Appendices:

Appendix A: Flake Tool Morphological Data

Morphologica Data: Column Codes

Type (Flake Tool Condition):	1=Complete; 2=Broken; 3=Fragment; 4=Shatter; 5=Indeterminant
Termination:	1=Feather; 2=Hinge; 3=Step; 4=Plunging; 5=Indeterminant
Material:	1=Fort Payne; 2=Knox Black; 3=Knox Gray; 4=Knox Procelaneou; 5=Bangor; 6=St. Louis; 7=Monteagle; 8=Thermally Altered; 9=Chalcedony; 10=Quartzite; 11=Indeterminant
Lip:	1=Present; 2=Absent
Bulb:	1=Present; 2=Absent
Bulb Type:	1=Slight; 2=Medium; 3=Large

Appendix A

Table A.1: Flake Tool Morphological Data

Component	Art. #	Bag #	Condition	Termination	Weight	Length	Width	Thick.	Material	Lip	Bulb	Bulb Type
LA I	23	1315	1	2	5.51	48.61	14.66	6.61		1	1	1
LA I	160	1161	1	1	0.62	19.53	11.36	4.59	5	2	1	1
LA I	174	1297	1	3	1.34	23.48	11.05	4.46	1	2	1	1
LA I	227	1298	1	3	4.53	31.98	26.67	4.57	6	1	2	0
LA I	228	1281	2	4	2.37	23.75	17.76	5.43	5	2	2	0
LA I	263	1315	1	1	2.28	27.26	11.16	6.55	9	2	1	3
LA I	278	1287	1	2	3.1	27.14	18.11	5.25	3	2	1	3
LA I	285	1343	1	2	2.5	20.3	22.91	5.27	8	1	1	2
LA I	288	1360	1	1	3.19	35.28	25.86	3.92	5	2	2	0
LA I	292	1403	2	3	1.68	26.93	12.48	3.12	6	2	2	0
LA I	296	1362	3	3	0.45	22.37	11.88	2.09	7	1	1	2
LA I	394	1395	2	3	2.2	23.42	19.92	2.6	7	2	2	0
LA I	471	1242	1	4	3.9	29.55	20.96	4.88	5	1	2	0
LA I	476	1279	1	1	3.06	25.6	21.04	4.8	7	2	2	0
LA I	561	1298	1	4	2.45	31.18	14.63	5.71	7	2	2	0
LA I	576	1358	3	3	0.71	22.36	10.48	2.62	1	2	2	0
LA I	583	1281	1	1	0.72	22.98	8.68	2.85	2	1	2	0
LA I	596	1341	2	3	1.1	17.58	19.21	1.94	4	2	1	2
LA I	631	1315	1	4	2.76	25.3	20.6	3.35	1	2	1	2
LA I	642	1344	1	1	1.52	26.83	14.38	3.34	7	2	2	0
LA I	680	1241	1	1	1.61	21.18	19.55	3.66	2	1	2	0
LA I	733	1281	1	1	2.18	27.28	19.76	3.28	5	2	1	2
LA I	786	1240	1	1	0.9	23.09	13.57	3.3	5	1	1	2
LA I	827	1242	1	1	0.84	28.01	14.32	1.63	2	2	1	1
LA I	867	1242	1	1	1.23	21.78	17.11	2.9	2	2	1	2
LA I	876	1161	1	4	0.7	21.73	12.66	4.57	1	2	2	0

Table A.1 (Cont.): Flake Tool Morphological Data

Component	Art. #	Bag #	Condition	Termination	Weight	Length	Width	Thick.	Material	Lip	Bulb	Bulb Type
LA I	886	1242	1	1	2.06	24.12	17.56	6.9	1	1	2	0
LA I	1408.1	1408	5	3	1.77	24.32	18.19	3.61	1	2	1	1
LA II	8	437	1	1	0.86	14.6	18.99	4.98	1	1	1	1
LA II	14	677	3	2	4.17	26.72	18.65	7.46	7	0	2	1
LA II	31	1225	2	1	1.71	34.43	14.44	2.75	9	2	2	0
LA II	36	1213	1	1	5.32	37.75	23.88	6.43	5	1	1	2
LA II	71	676	1	1	1.03	18.09	17.76	2.43	5	1	1	2
LA II	75	1221	1	2	0.56	15.56	10.69	2.83	7	2	2	0
LA II	87	783	1	1	1.29	35.28	14.24	2.12	6	2	1	2
LA II	121	712	1	1	3.69	24.89	18.25	4	1	2	2	0
LA II	129	1243	3	3	2.48	32.87	15.12	2.33	5	0	2	0
LA II	294	792	1	3	1.15	23.05	19.75	1.99	1	2	1	1
LA II	423	674	1	2	1.34	15.15	16.47	3.58	5	2	1	3
LA II	487	1272	1	1	2.38	32.88	16.38	3.14	5	1	2	0
LA II	496	712	1	2	0.21	15.72	7.77	0.74	6	2	1	1
LA II	502	760	1	3	1.08	22.11	16.57	3.54	5	1	2	0
LA II	506	760	1	1	1.55	20.65	20.19	2.95	7	0	0	0
LA II	510	760	1	1	2.92	30.99	20.13	3.69	5	2	1	3
LA II	514	714	1	1	0.36	12.41	13.87	1.31	5	2	1	1
LA II	518	1234	3	3	4.57	33.43	24.34	5.31	7	0	2	2
LA II	532	791	1	1	3.1	32.35	22.09	2.75	12	1	1	3
LA II	541	1234	1	1	4.9	34.94	15.36	9.32	7	2	2	0
LA II	565	1423	1	2	1.15	26.68	16.245	2.73	7	2	1	1
LA II	571	1222	1	1	0.7	21.82	10.37	2.00	7	2	1	1
LA II	574	1225	1	1	2.38	32.79	18.29	4.63	7	2	1	1
LA II	575	1222	1	2	1.1	17.34	18.53	2.53	7	1	1	2
LA II	581	1259	1	3	2.08	28.6	17.98	3.01	5	2	2	1
LA II	582	1243	2	3	3.39	30.08	22.65	2.67	5	1	1	3

Table A.1 (Cont.): Flake Tool Morphological Data

Component	Art. #	Bag #	Condition	Termination	Weight	Length	Width	Thick.	Material	Lip	Bulb	Bulb Type
LA II	598	1425	1	1	0.79	24.76	12.03	2.39	4	2	1	1
LA II	609	711	1	1	1.67	18.21	18.33	4.06	5	1	1	3
LA II	619	1062	1	1	0.73	17.07	17.15	2.73	5	1	1	1
LA II	633	779	1	1	0.92	22.25	11.96	3.24	5	2	1	1
LA II	644	1243	1	1	11.71	49.96	30.5	7.89	1	1	1	3
LA II	649	1339	1	1	3.03	17.35	25.68	5.41	7	2	1	2
LA II	650	761	2	3	2.26	14.7	21.59	5.22	6	2	1	3
LA II	665	1062	3	3	15.76	48.97	35.41	8.63	1	0	2	2
LA II	667	791	1	1	1.74	32.59	10.46	4.25	5	2	2	0
LA II	673	544	1	2	2.91	26.54	15.06	6.52	5	1	1	1
LA II	696	644	3	3	0.81	23.72	13.88	2.5	5	0	2	2
LA II	738	1068	1	4	1.63	16	24.06	4.84	2	2	1	3
LA II	759	793	2	4	0.92	15.84	8.86	4.2	1	2	1	1
LA II	774	1225	2	3	0.82	17.11	17.83	3.21	7	1	2	0
LA II	775	1313	1	2	0.88	17.2	17.02	2.15	2	2	1	1
LA II	849	760	1	2	0.77	13.62	16.6	1.89	7	2	1	1
LA II	855	1335	3	3	0.6	22.06	10.25	2.05	5	0	2	2
LA II	890	1225	3	5	0.58	14.74	11.18	3.84	7	0	2	2
LA II	895	791	1	5	0.56	12.61	14.39	2.14	7	2	1	1
LA II	69	1317	4	3	0.98	19.18	7.79	4.47	1	0	2	2
LA II	100	1221	2	3	1.71	21.42	22.03	2.5	5	2	1	3
LA II	105	783	1	1	1.8	29	18.14	4.11	1	2	1	1
LA II	300	1216	3	5	4.38	29.78	17.26	5.44	1	0	2	2
LA II	917	736	2	3	1.71	20.94	17.62	3.97	6	2	0	0
LA II	712.1	712	5	3	0.48	20.35	8.94	3.69	1	0	0	0
LA III	02	551	3	3	0.27	15.67	10.48	1.29	2	0	0	0
LA III	06	573	1	4	2.26	20.97	26.79	5.09	2	0	1	1
LA III	07	481	1	1	4.05	38.79	21.71	7.66	5	2	1	2

Table A.1 (Cont.): Flake Tool Morphological Data

Component	Art. #	Bag #	Condition	Termination	Weight	Length	Width	Thick.	Material	Lip	Bulb	Bulb Type
LA III	017	569	1	1	6.02	44.77	20.22	5.01	1	2	1	3
LA III	025	798	1	2	2.1	21.63	19.21	2.75	1	1	1	3
LA III	039	1210	1	3	3.31	25.04	17.69	3.68	5	1	1	2
LA III	047	94	1	3	6.03	31.41	24.03	6.9	5	2	1	3
LA III	049	299	1	4	1.49	19.86	20.83	3.8	7	2	1	1
LA III	056	119	1	2	0.49	18.34	13.91	1.68	7	2	1	1
LA III	060	649	3	3	1.37	27.7	9.37	4.36	5	0	2	2
LA III	064	518	3	3	1.77	22.36	17.17	4.24	5	0	0	0
LA III	067	598	3	3	5.57	38.12	18.42	6.8	5	0	0	0
LA III	073	604	1	1	3.31	30.34	21.39	5.31	8	1	2	0
LA III	081	572	3	3	2.05	21.68	18.06	1.9	1	0	0	0
LA III	082	60	1	3	5.34	30.16	18.08	6.59	7	2	2	0
LA III	085	1253	1	1	1.04	28.23	12.72	2.61	5	1	2	0
LA III	089	331	3	3	1.13	27.54	13.59	1.6	1	1	2	0
LA III	091	394	3	3	0.98	15.57	17.97	2.63	5	2	1	1
LA III	099	553	1	1	6.23	35.72	19.98	7.84	1	2	1	1
LA III	112	573	1	1	2.33	28.25	12.93	4.31	5	1	1	2
LA III	133	510	1	2	0.97	16.54	15.61	2.57	5	2	1	1
LA III	142	518	2	3	2.57	19.28	16.67	5.92	7	2	1	3
LA III	156	449	1	1	0.79	17.67	11.79	1.64	2	2	2	0
LA III	158	606	1	1	4.15	40.37	15.61	4.2	1	2	1	1
LA III	159	429	3	3	0.52	17.88	13.3	2.5	1	0	0	0
LA III	176	668	1	1	1.08	21.07	17.06	2.51	5	1	2	0
LA III	183	691	1	3	1.86	30.5	17.05	3.96	1	2	2	0
LA III	192	501	1	1	0.93	15.48	15	4.16	1	2	1	2
LA III	198	691	3	3	4.12	34.55	16.58	8.45	5	0	0	0

Table A.1 (Cont.): Flake Tool Morphological Data

Component	Art. #	Bag #	Condition	Termination	Weight	Length	Width	Thick.	Material	Lip	Bulb	Bulb Type
LA III	199	747	3	4	4.79	26.74	20.71	5.75	8	2	2	0
LA III	220	75	1	1	7.88	41.63	22.2	5.54	1	2	1	3
LA III	226	380	1	1	2.67	35.66	14.62	4.21	5	2	1	1
LA III	241	551	1	3	0.72	11.36	13.14	3.89	5	2	1	1
LA III	262	598	1	1	1.26	19.8	14.73	4.69	5	2	2	0
LA III	265	434	3	4	13.94	30.41	35.97	11.11	1	2	1	3
LA III	273	100	3	3	2.92	34.35	14.26	4.36	2	2	2	1
LA III	275	307	3	4	2.3	28.01	14.46	3.75	5	1	1	1
LA III	289	1228	3	3	3.54	28.83	20.53	7.98	5	0	0	0
LA III	290	1228	1	1	3.74	35.16	17.55	4.48	1	2	2	0
LA III	291	167	3	3	2.1	27.63	22.62	3.18	8	0	2	0
LA III	310	585	2	3	1.24	20.64	13.44	3.01	5	1	1	2
LA III	316	412	1	1	0.62	18.83	14.29	1.55	2	1	2	0
LA III	225	598	1	2	14.88	40.47	37.67	8.3	1	2	2	0
LA III	331	560	2	2	2.12	20.92	27.25	2.39	5	0	1	2
LA III	397	604	1	2	0.6	18.79	14.9	1.26	5	2	1	1
LA III	405	465	1	1	0.91	25.78	10.6	2.62	2	2	1	1
LA III	428	591	1	2	1.72	19.08	20.87	3.2	5	1	1	2
LA III	432	648	2	3	0.94	15.73	12.53	1.88	1	0	2	0
LA III	436	561	1	1	1.6	24.8	15.95	3.25	5	2	2	2
LA III	444	719	2	3	0.49	12.02	14.52	2.36	7	2	1	1
LA III	450	242	1	1	1.03	22.11	15.86	2.68	1	2	2	0
LA III	454	61	2	5	1.77	27.59	13.28	3	5	2	1	2
LA III	466	750	1	2	1.1	22.24	10.32	4.05	1	2	2	0
LA III	469	174	2	1	0.91	31.54	14.39	1.17	5	0	0	1
LA III	482	1228	2	3	4.64	25.96	22.44	6.36	1	2	0	1

Table A (Cont.): Flake Tool Morphological Data

Component	Art. #	Bag #	Condition	Termination	Weight	Length	Width	Thick.	Material	Lip	Bulb	Bulb Type
LA III	489	75	1	1	1.47	33.01	13.39	3.47	6	2	2	1
LA III	491	329	1	1	1.01	31.84	11.73	2.75	5	2	1	1
LA III	492	380	1	3	0.59	16.41	13.61	1.86	1	2	2	2
LA III	493	650	1	2	0.98	22.96	12.97	1.89	1	1	1	1
LA III	499	475	3	3	0.51	16.46	13.39	1.6	2	0	0	0
LA III	507	551	1	2	2.04	29.75	15.77	3.96	5	2	1	1
LA III	516	508	1	1	2.84	38.4	12.24	2.34	6	1	2	0
LA III	519	329	3	3	0.78	16.52	12.97	3.11	2	0	0	0
LA III	522.1	522	2	4	0.44	18.42	8.98	2.39	5	2	0	2
LA III	525	424	3	3	0.56	20.18	9.35	1.81	5	1	1	1
LA III	526	585	1	1	1.12	26.46	13.86	3.31	5	2	1	1
LA III	546	598	2	1	0.7	24.9	13.45	1.97	5	0	0	0
LA III	557	509	3	3	0.82	19.11	13.38	2.06	7	2	1	1
LA III	600	1228	1	1	0.87	17.37	10.97	3.48	5	1	2	0
LA III	567	598	1	1	8.88	41.79	19	8.05	5	2	2	0
LA III	614	448	1	2	1.69	21.45	16.49	3.59	5	2	2	0
LA III	624	579	1	1	0.59	15.89	11.26	2.95	5	2	1	1
LA III	629	572	3	3	4.94	29.03	20.48	6.36	1	2	2	0
LA III	630	630	1	1	3.56	29.45	16.28	6.84	2	2	2	0
LA III	639	353	1	2	2.52	27.74	15.99	4	1	1	1	2
LA III	654	307	1	1	0.65	18.11	14.64	1.84	5	2	1	3
LA III	658	66	3	3	3.49	34.6	16.18	4.55	2	2	2	1
LA III	664	566	3	3	0.22	11.92	6.38	2.37	7	0	0	0
LA III	672	747	3	3	1.32	19.64	14.82	2.65	1	2	1	1
LA III	675	578	1	1	3.68	45.3	22.45	2.26	1	1	1	1
LA III	681	604	1	4	1.5	19.93	20.1	4.15	5	1	1	1

Table A.1 (Cont.): Flake Tool Morphological Data

Component	Art. #	Bag #	Condition	Termination	Weight	Length	Width	Thick.	Material	Lip	Bulb	Bulb Type
LA III	697	94	3	3	0.66	20.86	11.68	1.89	7	2	1	1
LA III	703	425	1	1	0.52	16.89	12.48	2.02	1	2	2	1
LA III	705	604	1	4	0.55	15.68	13.83	1.52	5	2	1	1
LA III	714	718	1	1	0.51	20.69	9.29	2.7	5	2	2	0
LA III	716	1228	1	1	1.61	14.9	18.64	4.88	7	2	1	2
LA III	728	606	4	3	2.82	18.7	23.84	6.65	5	0	0	0
LA III	734	429	1	4	3.64	20.55	24.88	6.65	5	2	2	0
LA III	742	1200	1	1	2.86	31.32	18.05	4.25	2	2	1	3
LA III	750	526	1	2	1.17	24.45	9.71	2.56	3	2	1	1
LA III	752	1200	1	1	1	16.13	17.18	3.06	5	2	2	1
LA III	760	509	3	3	0.24	10.46	9.32	1.36	5	0	0	0
LA III	763	604	1	1	0.98	19.26	13.39	3.08	5	2	2	1
LA III	765	1228	3	3	1.05	26.43	12.07	3.76	5	0	0	0
LA III	789	552	1	1	0.28	13.47	9.1	2.06	5	1	1	2
LA III	793	1228	4	3	7.25	29.73	22.82	8.92	9	0	0	0
LA III	802	549	1	1	1.06	17.36	14.95	3.33	9	1	1	1
LA III	811	566	2	4	0.88	17.95	10.57	3.14	7	2	1	2
LA III	824	452	3	3	0.88	17.95	10.57	3.14	7	0	1	3
LA III	832	119	1	1	0.88	23.25	11.74	3.75	1	2	1	1
LA III	833	463	1	2	3.22	27.23	14.49	6.8	1	2	2	2
LA III	877	607	2	3	1.29	16.81	18.43	2.78	2	2	1	1
LA III	878	588	1	1	0.37	21.36	7.72	2.13	1	2	2	0
LA III	891	585	2	3	0.88	14.08	15.78	3.66	7	2	1	1
LA III	897	438	1	1	1.8	23.94	15.98	4.4	5	2	2	2
LA III	024	650	3	3	0.49	15.66	7.07	4.49	1	0	0	0
LA III	062	608	1	4	8.55	30.87	31.04	8.41	5	2	1	1

Table A.1 (Cont.): Flake Tool Morphological Data

Component	Art. #	Bag #	Condition	Termination	Weight	Length	Width	Thick.	Material	Lip	Bulb	Bulb Type
LA III	083	585	3	3	0.38	8.01	11.31	2.9	1	0	0	0
LA III	164	353	4	3	6.46	29.76	12.35	10.52	1	0	0	0
LA III	217	605	3	3	10.95	39.88	28.46	7.24	1	2	1	2
LA III	255	588	4	3	11.07	38.13	22.24	12.29	5	0	0	0
LA III	301	280	1	1	5.29	31.99	17.93	9.6	5	2	2	0
LA III	323	382	2	3	16.28	28.6	40.21	12.6	1	2	1	3
LA III	451	1228	1	4	3.33	25.99	14.22	6.51	6	2	1	1
LA III	505	387	3	3	2.79	21.07	15.32	5.74	1	2	0	0
LA III	899	336	5	3	0.77	21.76	6.33	3.7	5	0	0	0
LA III	902	383	5	4	1.55	23.03	11.51	4.5	1	0	0	0
LA III	910	572	5	4	1.28	24.99	6.81	3.94	1	0	0	0
LA III	915	353	4	3	3.16	27.42	12.05	8.62	2	0	0	0
MW	003	245	1	4	3.54	27.86	25.16	5.39	2	2	1	2
MW	011	679	1	2	0.89	16.97	22.64	2.87	5	2	1	3
MW	026	125	3	3	3.9	18.83	29.42*	5.84	5	2	2	0
MW	029	318	3	3	0.61	12.63	21.03	2.03	7	1	1	2
MW	034	90	3	3	1.01	15.11	7.95	4.02	12	0	0	0
MW	059	365	2	2	1.09	15.36	15.46	3.01	7	0	0	0
MW	063	295	2	3	0.55	18.48	10.49	3.68	8	2	1	2
MW	065	856	2	4	0.8	24.46	13.03	3.38	5	2	1	1
MW	072	247	2	4	1.57	24.36	18.4	2.58	3	2	2	0
MW	074	258	1	1	1.04	21.39	13.26	2.28	1	0	0	0
MW	090	364	2	1	1.2	23.69	15.52	1.86	12	2	2	1
MW	103	315	3	3	0.36	12.34	6.63	2.41	7	1	1	1
MW	118	351	1	2	1.72	22.99	23.14	2.78	7	1	1	1
MW	120	758	1	1	1.6	26.27	14.48	3.01	5	1	2	1

Table A.1 (Cont.): Flake Tool Morphological Data

Component	Art. #	Bag #	Condition	Termination	Weight	Length	Width	Thick.	Material	Lip	Bulb	Bulb Type
MW	127	441	1	4	1.19	20.66	11.14	3.63	2	1	2	1
MW	125	445	1	1	8.43	58.93	21.59	6.13	5	2	2	0
MW	153	364	1	4	11.6	28.43	3.82	9.76	5	1	1	1
MW	151	77	1	2	3.06	23.8	21.47	2.94	7	0	0	0
MW	154	295	1	2	5.79	32.42	25.45	5.49	7	0	0	0
MW	157	438	1	1	2.25	33.45	15.12	4.02	5	2	2	1
MW	165	245	4	5	13.17	24.98	24.76	13.21	5	1	1	3
MW	168	365	1	1	1.4	25.68	14.02	2.97	7	2	1	1
MW	171	699	2	3	1.29	24.59	16.44	3.33	5	2	1	1
MW	189	258	1	2	8.4	46.77	20.12	7.12	2	0	0	0
MW	197	15	4	3	1.15	20.9	9.15	5.1	8	1	2	0
MW	201	365	1	4	0.86	22.03	10.33	3.6	2	2	1	3
MW	202	725	3	3	2.43	24.01	21.13	4.56	7	0	0	0
MW	208	699	1	1	3.24	22.42	19.76	6.2	2	0	0	0
MW	212	233	3	3	2.85	14.65	23.44	7.09	5	0	0	0
MW	218	1244	2	3	1.47	23.53	19.03	2.37	1	2	2	0
MW	222	741	1	1	1.86	23.65	15.05	4.3	6	2	2	0
MW	224	213	3	3	7.47	29.32	23.52	7.83	5	2	1	1
MW	230	107	1	1	1.31	22.21	16.19	2.85	7	2	1	2
MW	231	205	1	1	3.26	35.13	24.08	4.31	5	2	1	3
MW	242	1397	1	3	0.82	21.97	5.77	2.97	12	2	1	1
MW	257	758	4	4	3.41	30.86	14.62	5.34	5	2	1	2
MW	261	295	4	3	1.38	18.72	7.21	4.41	7	2	1	1
MW	271	70	4	4	12.15	39.05	16.08	12.62	2	1	2	0
MW	272	365	1	4	1.83	23.31	21.68	3.87	3	1	1	1
MW	280	1265	1	2	3.6	26.25	19.02	4.1	3	2	1	2

Table A.1 (Cont.): Flake Tool Morphological Data

Component	Art. #	Bag #	Condition	Termination	Weight	Length	Width	Thick.	Material	Lip	Bulb	Bulb Type
MW	281	1363	1	2	1.8	25.62	15.47	3.98	7	1	1	1
MW	286	318	3	3	1.54	26.13	19.44	2.93	6	2	1	1
MW	292	143	3	3	1.68	26.93	12.48	3.12	3	2	1	1
MW	293	245	1	2	3.8	33.63	18.98	4.01	2	2	2	0
MW	295	1332	3	3	2.83	26.81	21.4	3.71	5	2	1	2
MW	303	351	3	3	0.39	13.46	6.55	1.92	6	2	1	2
MW	304	365	3	3	2.21	32.31	14.09	4.6	6	2	1	2
MW	306	1382	4	3	22.85	55.79	13.1	16.77	2	2	2	0
MW	315	1128	1	1	5	20.9	27.59	8.15	5	2	1	3
MW	330	1352	1	2	1.31	22.21	16.19	2.85	2	2	1	1
MW	356	1382	1	2	2.58	20.78	25.24	3.92	5	2	2	0
MW	359	1385	1	4	2.93	26.37	17.3	5	5	2	1	3
MW	375	248	1	2	0.53	20.97	10.44	2.37	7	2	2	0
MW	392	1369	1	1	1.34	19.95	20.28	3.43	5	2	2	0
MW	395	90	1	2	1.11	13.74	19.22	3.08	6	0	0	0
MW	411	732	1	2	3.4	26.84	15.62	5.98	7	1	2	0
MW	419	1352	1	4	2.48	17.81	21.45	5.73	7	2	1	1
MW	429	1333	1	1	0.8	16.45	13.19	2.8	5	1	1	3
MW	434	365	1	4	2.32	21.74	22.1	3.5	7	0	0	0
MW	439	758	1	2	2.77	25.07	22.89	3.5	5	2	1	1
MW	455	242	2	3	1.18	19.77	11.28	3.01	12	1	1	2
MW	457	1411	1	1	2.29	24.45	15.87	3.45	5	2	1	1
MW	460	699	2	4	3.52	18.36	24.07	5.9	5	0	0	0
MW	463	1439	1	4	1.31	21.19	18.17	2.75	8	0	0	0
MW	464	129	1	2	4.02	38.5	26.67	3.77	7	2	1	3
MW	474	205	1	4	1.54	32.16	23.29	2	7	0	2	0

Table A.1 (Cont.): Flake Tool Morphological Data

Component	Art. #	Bag #	Condition	Termination	Weight	Length	Width	Thick.	Material	Lip	Bulb	Bulb Type
MW	475	1100	1	1	0.85	16.42	12.63	3.24	5	2	2	0
MW	479	1266	1	1	1.6	19.2	14.5	2.86	5	2	1	1
MW	481	1233	1	2	2.29	27.93	17.11	4.73	5	0	0	0
MW	495	144	1	1	1.49	26.97	13.58	1.91	1	2	2	0
MW	501	49	2	4	7.08	23.36	34.21	5.53	7	2	1	1
MW	504	90	1	3	0.64	23.31	10.11	2.2	1	2	1	3
MW	513	249	2	3	1.78	14.25	18.85	4.4	2	2	1	2
MW	522	669	1	3	2.53	18.73	17.74	5.99	12	0	0	0
MW	527	365	1	3	0.58	18.26	14.47	1.75	12	2	2	0
MW	530	365	2	4	0.78	13.77	15.22	3.37	7	2	2	0
MW	540	310	1	1	2.23	32.13	17.34	3.99	5	2	2	0
MW	551	77	1	2	1.24	23.79	13.99	3.35	6	2	2	0
MW	560	365	3	3	0.74	21.96	11.9	1.52	7	2	1	1
MW	562	1293	1	4	3.19	24.33	19.03	4.66	1	0	0	0
MW	572	125	1	2	1.24	3.28	12.63	2.62	6	0	2	0
MW	578	365	1	1	1.52	22.12	22.15	4.16	6	2	1	3
MW	580	208	4	3	5.4	44.1	11.09	7.17	5	2	2	0
MW	623	737	1	1	0.61	13.67	13.94	3.19	7	1	1	1
MW	627	125	1	1	5.56	34.35	32.56	5.87	5	2	1	2
MW	646	208	2	3	1.95	24.29	12.9	3.3	5	2	1	3
MW	648	295	1	4	2.31	30.17	20.64	3.34	5	2	1	1
MW	661	1288	1	1	0.9	23.91	12.08	1.81	7	0	0	0
MW	676	107	3	3	2.81	20.17	21.13	4.12	6	1	1	1
MW	704	699	1	2	1.13	23.02	15.1	3.55	5	2	2	0
MW	724	284	3	3	1.64	31.5	16.62	1.71	1	0	0	0
MW	731	153	1	1	0.25	13.22	9.73	1.52	1	2	2	0

Table A.1 (Cont.): Flake Tool Morphological Data

Component	Art. #	Bag #	Condition	Termination	Weight	Length	Width	Thick.	Material	Lip	Bulb	Bulb Type
MW	741	1201	3	3	1.78	21.77	15.13	2.42	2	0	0	0
MW	751	1411	1	1	0.78	24.06	11.72	2.93	5	0	0	0
MW	797	985	3	3	1.22	19.04	14.16	5.14	1	0	0	0
MW	798	369	1	1	0.67	21.37	11.46	2.09	7	0	2	0
MW	834	131	2	1	1.17	20.27	15.5	3.88	5	0	0	0
MW	845	245	1	1	0.41	18.88	12.74	1.41	1	0	0	0
MW	847	1128	1	1	0.5	17.02	13.22	2.1	1	0	0	0
MW	848	327	1	2	1.06	15.03	16.34	2.62	7	0	0	0
MW	854	1237	3	3	3.2	26.42	21.13	4.12	5	0	1	0
MW	859	744	1	2	2.5	21.97	22.5	5.03	5	1	1	1
MW	860	1382	3	3	0.47	23.32	9.13	1.91	1	0	0	0
MW	874	323	1	1	0.99	24.91	12.48	2.25	6	0	1	0
MW	888	226	1	1	1.39	17.88	15.6	3.79	1	0	0	0
MW	898	831	3	3	4.56	25.96	16.89	6.92	7	0	0	0
MW	901	144	1	4	1.4	17.34	16.3	3.18	2	1	0	0
MW	903	144	1	4	1.91	17.05	16.83	5.47	5	0	0	0
MW	919	921	1	4	0.23	20.28	5.26	3.05	2	0	0	0
MW	921	310	1	4	2.02	25.28	19.25	3.98	2	0	0	0

Appendix B: Flake Tool Technological and Functional Data

Technological and Functional Data: Column Codes

Type (Flake Tool Type):	1=Use-modified; 2=Retouched; 3=Formally Retouched
Edge Shape:	1=Straight; 2=Concave; 3=Convex; 4=Pointed
Edge Angle:	1= <20° 2= 20°; 3= 30°; 4= 40°; 5= 50°; 6= 60°; 7= 70°; 8= 80°
Polish Stage:	1=Generic; 2=Smooth-Pitted; 3=Developed
Hardess (Material Worked)	1=Soft; 2=Soft/Medium; 3=Medium; 4=Medium/Hard; 5=Hard
Use-Action:	1=Transverse; 2=Longitudinal; 3=Both; 4=Graving; 5=Wedging; 6=Projection; 7=Unsure
Polish Type:	1=Bone/Antler; 2=Wood/Woody Plant; 3=Dry/Greased Hide; 4=Fresh Meat/Hide; 5=Plant; 6=Unsure
Striations:	1=Present; 2=Absent
Orientation (Striation):	1=Perpendicular; 2=Parallel; 3=Both
Rounding:	1=Yes; 2=No

Appendix B

Table B.1: Technological and Functional Data

Component	Artifact #	Tool Type	Edge Shape	Edge Angle	Polish Stage	Hardness	Use-Action	Polish Type	Striations	Orienation	Rounding
LA I	023	1	1	7	2	1	2	6	2	0	2
LA I	160	2	1	6	3	2	4	2	2	0	2
LA I	174	1	1	7	1	3	1	6	1	1	1
LA I	227	1	1	5	2	4	1	6	1	1	1
LA I	228	1	1	7	3	4	1	2	2	0	2
LA I	263	1	2	7	2	5	1	1	1	1	2
LA I	278	1	4	7	2	4	4	6	2	0	2
LA I	285	1	1	6	1	4	1	6	1	2	2
LA I	288	1	3	6	2	1	2	4	1	1	2
LA I	292	1	3	6	3	5	1	1	2	1	1
LA I	296	1	1	1	0	1	1	0	1	1	2
LA I	394	1	1	5	1	5	1	6	1	1	2
LA I	471	1	1	7	3	3	1	2	1	2	2
LA I	476	1	3	1	2	2	2	6	2	1	2
LA I	561	1	1	3	0	3	1	0	2	1	2
LA I	576	1	2	7	1	5	1	6	1	1	2
LA I	583	1	1	2	2	3	1	6	2	1	2
LA I	596	1	1	5	0	3	1	0	2	1	2
LA I	631	1	1	6	1	4	1	6	1	1	2
LA I	642	1	1	6	2	4	1	6	1	1	2
LA I	680	1	2	5	2	4	1	6	1	1	1
LA I	733	1	1	6	1	4	1	6	1	2	2
LA I	786	2	1	7	1	5	1	6	1	1	2
LA I	827	1	3	2	2	1	2	6	1	1	2
LA I	867	1	1	5	3	5	1	2	2	1	2
LA I	876	1	1	6	2	5	1	6	1	1	1

Table B.1 (Cont.): Technological and Functional Data

Component	Artifact #	Tool Type	Edge Shape	Edge Angle	Polish Stage	Hardness	Use-Action	Polish Type	Striations	Orienation	Rounding
LA I	886	1	1	4	1	4	1	6	2	0	2
LA I	1408.1	2	4	7	3	5	1	1	1	1	1
LA II	008	1	1	2	2	2	1	6	1	1	1
LA II	014	1	3	7	3	4	1	2	1	1	2
LA II	031	1	3	5	2	2	1	6	1	1	2
LA II	036	1	1	8	1	5	1	6	2	0	2
LA II	069	2	4	8	1	5	4	6	2	0	1
LA II	071	1	1	5	1	4	1	6	1	1	1
LA II	075	1	1	5	2	1	1	6	1	2	2
LA II	087	1	1	2	3	1	2	4	2	0	2
LA II	100	2	4	6	2	4	1	6	1	1	1
LA II	105	2	1	7	3	4	1	2	1	1	2
LA II	121	1	3	7	0	5	1	0	1	1	1
LA II	129	1	2	6	1	5	1	6	2	0	1
LA II	294	1	2	5	3	5	1	1	1	3	2
LA II	300	2	2	8	3	1	2	4	1	1	2
LA II	423	1	1	7	1	2	1	6	2	0	1
LA II	487	1	1	6	1	2	1	6	1	1	2
LA II	496	1	1	6	1	2	1	6	1	1	1
LA II	502	1	3	5	1	4	1	6	1	1	2
LA II	506	1	4	5	0	2	1	0	2	0	2
LA II	510	1	1	2	3	4	1	4	1	1	2
LA II	514	1	1	3	2	2	1	6	1	1	2
LA II	518	1	3	6	3	5	1	1	1	2	1
LA II	532	1	1	7	2	1	1	6	1	2	1
LA II	541	1	1	6	3	5	1	1	1	1	1
LA II	565	1	1	7	3	1	3	4	1	1	2
LA II	571	1	3	7	2	1	2	6	2	0	2

Table B.1 (Cont.): Technological and Functional Data

Component	Artifact #	Tool Type	Edge Shape	Edge Angle	Polish Stage	Hardness	Use-Action	Polish Type	Striations	Orienation	Rounding
LA II	574	1	3	6	3	2	2	4	2	0	1
LA II	575	1	1	4	1	3	1	6	1	3	1
LA II	581	1	3	8	3	5	1	1	1	1	1
LA II	582	1	1	5	3	5	3	1	1	2	1
LA II	598	1	2	5	1	3	1	6	2	0	2
LA II	609	1	3	3	3	4	2	4	1	1	1
LA II	619	1	1	7	1	2	1	6	1	1	1
LA II	633	1	1	5	3	2	2	2	1	3	1
LA II	644	1	1	6	1	3	1	6	1	1	2
LA II	649	1	1	6	3	1	1	5	1	2	2
LA II	650	1	4	2	1	2	1	6	2	0	2
LA II	665	1	4	6	1	5	5	6	1	1	2
LA II	667	1	1	6	3	3	1	1	1	1	2
LA II	673	1	1	7	1	5	2	6	1	1	2
LA II	696	1	1	6	1	4	1	6	1	1	2
LA II	712.1	2	1	7	2	3	1	6	1	1	1
LA II	738	1	1	5	2	4	1	6	1	1	1
LA II	759	1	3	6	1	2	2	6	1	1	1
LA II	774	1	3	7	2	4	1	6	1	1	1
LA II	775	1	3	7	3	2	1	4	0	0	2
LA II	849	1	1	6	3	5	1	4	1	1	1
LA II	855	1	1	5	3	2	1	1	1	1	1
LA II	890	1	4	6	1	2	6	6	2	0	1
LA II	895	2	4	2	2	1	6	6	1	1	2
LA II	917	3	4	8	2	1	6	6	2	0	1
LA III	002	1	1	6	1	1	1	6	1	1	1
LA III	006	1	2	6	3	5	1	1	1	1	2
LA III	007	1	1	6	1	4	2	6	2		1

Table B.1 (Cont.): Technological and Functional Data

Component	Artifact #	Tool Type	Edge Shape	Edge Angle	Polish Stage	Hardness	Use-Action	Polish Type	Striations	Orienation	Rounding
LA III	017	1	2	6	1	2	3	6	1	2	1
LA III	024	2	1	8	1	3	1	6	1	1	1
LA III	025	1	2	6	1	4	1	6	1	2	1
LA III	039	1	3	2	3	1	2	6	2	2	2
LA III	047	1	1	3	1	5	1	6	1	1	1
LA III	049	1	3	2	2	3	1	6	1	1	1
LA III	056	1	1	6	2	2	1	6	2	0	2
LA III	060	1	1	7	0	5	5	6	1	1	2
LA III	062	2	2	7	3	5	1	2	2	0	2
LA III	064	1	1	6	2	4	1	6	0	0	0
LA III	067	1	1	7	3	5	1	1	1	3	1
LA III	073	1	4	6	0	4	1	6	1	1	1
LA III	081	1	1	7	3	3	3	4	1	1	1
LA III	082	1	2	6	3	2	1	3	1	2	1
LA III	083	2	4	8	0	6	6	6	1	3	1
LA III	085	1	1	5	1	3	1	6	2	0	1
LA III	089	1	1	6	3	4	3	4	2	0	2
LA III	091	1	1	6	3	2	3	4	2	0	2
LA III	099	1	1	5	0	4	1	6	1	1	2
LA III	112	1	1	6	1	2	1	6	1	1	2
LA III	133	1	2	7	0	4	1	6	1	2	1
LA III	142	1	2	7	3	2	1	5	2	0	1
LA III	156	1	1	3	1	2	1	6	1	1	1
LA III	158	1	3	6	1	1	2	6	2	0	2
LA III	159	1	1	6	1	3	1	6	2	0	1
LA III	164	2	1	7	0	6	7	6	1	1	1

Table B.1 (Cont.): Technological and Functional Data

Component	Artifact #	Tool Type	Edge Shape	Edge Angle	Polish Stage	Hardness	Use-Action	Polish Type	Striations	Orienation	Rounding
LA III	176	1	1	6	2	2	1	6	1	1	2
LA III	183	1	4	6	1	3	6	6	1	2	2
LA III	198	1	4	6	2	4	4	6	3	3	3
LA III	199	1	1	4	1	4	1	6	1	2	1
LA III	217	2	3	6	3	3	2	2	2	0	2
LA III	220	1	2	6	2	4	2	6	2	0	1
LA III	225	1	4	7	1	1	4	6	1	1	2
LA III	226	1	1	6	1	1	6	6	1	1	2
LA III	241	2	4	8	0	3	1	6	2	0	2
LA III	255	3	4	7	0	1	6	6	1	1	1
LA III	262	1	1	7	1	1	2	6	0	0	2
LA III	265	1	1	6	3	5	1	1	1	1	2
LA III	273	1	1	6	3	5	1	1	2	0	2
LA III	275	1	2	7	3	5	1	1	1	1	2
LA III	289	1	1	6	1	3	1	6	1	2	1
LA III	290	1	3	7	1	5	1	6	1	2	1
LA III	291	2	1	7	2	2	1	6	1	1	2
LA III	301	2	1	6	3	5	1	1	1	1	1
LA III	310	1	2	5	3	5	1	1	1	1	2
LA III	316	1	2	7	3	5	1	1	1	1	2
LA III	323	1	4	4	1	5	1	6	2	0	1
LA III	331	1	1	7	3	3	3	4	1	3	2
LA III	397	1	1	5	3	2	2	4	2	0	1
LA III	405	1	1	4	2	1	2	6	1	2	1
LA III	428	1	3	6	2	3	4	6	0	0	1
LA III	432	1	1	6	1	2	1	6	1	2	1
LA III	436	1	1	6	1	3	1	6	2	2	0

Table B.1 (Cont.): Technological and Functional Data

Component	Artifact #	Tool Type	Edge Shape	Edge Angle	Polish Stage	Hardness	Use-Action	Polish Type	Striations	Orienation	Rounding
LA III	444	1	3	6	2	1	2	6	2	0	0
LA III	450	1	2	2	1	1	1	6	2	2	2
LA III	451	2	2	7	3	5	1	1	1	1	2
LA III	454	1	1	5	3	4	3	1	1	1	2
LA III	466	1	1	3	0	3	1	6	1	1	1
LA III	469	1	1	2	3	2	2	4	0	0	1
LA III	482	1	1	3	1	2	1	6	0	0	0
LA III	489	1	1	5	3	1	3	4	0	0	2
LA III	491	1	1	2	0	1	2	6	2	0	2
LA III	492	1	1	3	0	3	1	6	1	2	1
LA III	493	1	4	5	0	3	1	6	1	2	1
LA III	499	1	1	5	1	3	1	6	2	0	0
LA III	505	2	1	6	0	5	5	6	1	1	2
LA III	507	1	3	6	1	2	1	6	0	0	1
LA III	516	1	3	6	3	5	1	1	1	3	1
LA III	519	1	1	7	1	3	1	6	0	0	0
LA III	522.1	1	4	6	1	1	6	6	2	0	1
LA III	525	1	1	6	2	3	1	6	1	1	1
LA III	526	1	4	6	1	2	1	6	0	0	1
LA III	546	1	1	5	1	2	2	6	1	2	1
LA III	557	1	1	7	1	1	1	6	0	0	1
LA III	567	1	3	6	3	3	4	2y	1	1	1
LA III	600	1	4	6	2	3	1	6	1	3	1
LA III	614	1	1	8	3	3	1	2	0	0	0
LA III	624	1	1	6	1	2	3	6	1	3	1
LA III	629	1	3	7	1	5	1	6	1	1	1
LA III	630	1	3	5	1	2	2	6	0	3	2
LA III	639	1	1	8	3	5	1	2	0	0	2

Table B.1 (Cont.): Technological and Functional Data

Component	Artifact #	Tool Type	Edge Shape	Edge Angle	Polish Stage	Hardness	Use-Action	Polish Type	Striations	Orienation	Rounding
LA III	654	1	1	4	1	1	1	6	1	1	1
LA III	658	2	2	6	2	3	1	6	1	1	2
LA III	664	1	3	6	3	3	1	2	2	0	2
LA III	672	1	1	5	3	4	1	2	0	0	0
LA III	675	1	1	6	3	2	3	5	1	1	1
LA III	681	1	1	6	3	4	1	4	0	0	2
LA III	697	1	1	5	3	3	1	2	1	1	2
LA III	703	1	1	3	3	2	1	6	1	1	1
LA III	705	1	1	6	0	4	1	6	0	0	1
LA III	714	1	3	6	1	2	1	6	1	2	1
LA III	716	1	1	6	1	2	2	6	1	1	2
LA III	728	1	4	7	1	4	1	6	2	0	2
LA III	734	1	1	6	1	3	1	6	1	1	1
LA III	742	1	1	7	1	5	1	6	1	2	2
LA III	750	1	1	4	2	1	1	6	0	0	0
LA III	752	1	1	4	1	5	1	6	2	2	2
LA III	760	1	2	6	1	4	1	6	1	1	2
LA III	763	1	4	6	3	3	1	2	1	2	1
LA III	765	1	2	6	2	5	1	6	1	1	2
LA III	789	1	1	3	1	2	2	6	2	2	1
LA III	793	1	2	7	1	3	1	6	2	0	2
LA III	802	1	3	7	0	3	1	6	1	1	2
LA III	811	1	1	6	1	3	1	6	0	0	0
LA III	824	1	1	7	3	1	2	1	0	0	0
LA III	832	1	4	7	0	6	6	6	1	2	2
LA III	833	1	1	6	0	5	1	6	0	0	0
LA III	877	1	4	7	3	3	2	1	0	0	2
LA III	878	1	1	6	3	3	1	5	0	0	2

Table B.1 (Cont.): Technological and Functional Data

Component	Artifact #	Tool Type	Edge Shape	Edge Angle	Polish Stage	Hardness	Use-Action	Polish Type	Striations	Orienation	Rounding
LA III	891	1	1	7	1	3	1	6	2	2	2
LA III	897	1	1	7	3	2	1	2	0	0	0
LA III	899	3	4	8	1	1	6	6	0	0	0
LA III	902	2	4	8	3	1	6	3	0	0	0
LA III	910	3	4	8	1	3	6	6	0	0	2
LA III	915	3	4	8	1	5	6	6	0	0	2
MW	003	2	4	7	3	3	1	2	1	2	1
MW	011	1	1	5	0	3	2	6	1	1	2
MW	026	1	2	6	1	4	1	6	1	1	2
MW	029	1	1	6	3	5	1	1	1	1	2
MW	034	1	2	7	3	4	1	1	1	1	2
MW	059	1	1	8	3	5	1	1	1	1	1
MW	063	1	4	6	3	3	6	3	1	1	2
MW	065	1	2	8	3	5	1	1	1	2	1
MW	072	1	1	2	1	2	2	6	1	1	1
MW	074	1	3	5	2	1	1	6	1	3	2
MW	090	1	1	7	1	4	3	6	1	2	1
MW	103	2	1	7	3	3	1	2	1	1	1
MW	118	1	1	6	3	1	2	4	1	1	1
MW	120	1	1	4	3	5	1	1	1	2	1
MW	125	1	2	3	3	1	1	5	1	2	2
MW	127	2	4	9	1	1	4	6	1	1	1
MW	151	1	1	7	3	2	1	2	2	0	2
MW	153	1	1	6	3	3	1	4	2	0	2
MW	154	2	3	2	3	2	3	4	1	1	1
MW	157	1	1	6	3	3	2	4	1	2	1
MW	165	2	2	8	3	5	1	2	1	1	2
MW	168	1	1	6	3	4	1	1	1	1	1

Table B.1 (Cont.): Technological and Functional Data

Component	Artifact #	Tool Type	Edge Shape	Edge Angle	Polish Stage	Hardness	Use-Action	Polish Type	Striations	Orienation	Rounding
MW	171	1	1	3	1	3	1	6	1	2	1
MW	189	2	2	7	1	2	1	6	2	0	2
MW	197	1	1	6	3	5	1	1	1	1	2
MW	201	2	4	7	0	6	6	6	1	3	2
MW	202	1	1	7	3	2	1	3	1	3	1
MW	208	1	4	5	3	2	2	4	1	1	1
MW	212	1	1	6	2	5	1	6	1	1	2
MW	218	1	4	5	1	5	1	6	1	1	1
MW	222	1	1	6	2	5	1	6	1	3	1
MW	224	3	3	6	3	5	1	1	1	1	1
MW	230	2	1	6	2	2	1	6	1	1	1
MW	231	1	1	3	3	1	2	5	1	2	1
MW	242	1	2	7	3	5	1	1	2	0	2
MW	257	2	1	8	2	5	1	6	1	1	2
MW	261	1	1	6	1	4	5	6	1	3	2
MW	271	1	1	8	3	5	1	1	1	1	2
MW	272	1	2	7	3	3	1	2	1	1	2
MW	280	2	1	6	3	5	1	1	0	0	1
MW	281	2	4	7	1	2	3	6	1	2	1
MW	286	1	1	7	3	3	1	3	1	2	1
MW	292	1	1	6	3	2	3	4	1	1	1
MW	293	1	1	6	3	3	1	2	1	1	1
MW	295	1	2	7	1	5	1	6	1	2	1
MW	303	1	1	7	2	2	1	6	1	1	1
MW	304	1	1	7	3	2	2	4	1	1	1
MW	306	1	3	5	1	5	1	6	1	3	1
MW	315	1	3	7	1	3	1	6	1	1	1
MW	330	1	4	3	2	1	3	6	1	1	1

Table B.1 (Cont.): Technological and Functional Data

Component	Artifact #	Tool Type	Edge Shape	Edge Angle	Polish Stage	Hardness	Use-Action	Polish Type	Striations	Orienation	Rounding
MW	356	1	1	3	3	2	1	4	1	1	1
MW	359	1	1	5	2	3	1	6	1	1	2
MW	375	1	3	4	3	1	1	5	1	1	2
MW	392	1	1	5	3	5	2	1	0	0	1
MW	395	1	1	7	1	2	1	6	1	1	1
MW	411	1	1	5	3	1	1	3	2	0	2
MW	419	1	1	5	1	5	1	6	1	1	1
MW	429	1	1	5	2	5	4	6	1	1	2
MW	434	2	4	6	0	3	3	6	1	1	2
MW	439	1	2	5	3	4	1	4	1	3	1
MW	455	1	2	5	3	5	1	1	0	0	2
MW	457	1	1	3	2	2	1	6	1	3	1
MW	460	1	1	7	2	2	1	6	1	1	1
MW	463	1	1	5	1	4	1	6	1	2	1
MW	464	1	1	5	3	2	1	3	1	2	1
MW	474	1	3	2	3	1	1	5	2	0	2
MW	475	1	1	5	3	3	1	3	0	0	2
MW	479	1	4	5	1	2	1	6	0	0	1
MW	481	1	3	2	3	2	2	2	1	2	1
MW	495	1	1	5	1	2	1	6	1	1	1
MW	501	1	1	5	1	3	1	6	1	1	2
MW	504	1	1	5	3	3	2	1	1	1	2
MW	513	1	1	5	3	5	1	1	1	1	1
MW	522	1	1	8	3	2	1	2	1	1	1
MW	527	1	1	3	1	3	1	6	1	1	1
MW	530	1	1	7	3	5	2	1	2	0	2
MW	540	1	1	5	3	5	1	5	1	1	1
MW	551	1	1	5	3	2	1	2	2	3	3

Table B.1 (Cont.): Technological and Functional Data

Component	Artifact #	Tool Type	Edge Shape	Edge Angle	Polish Stage	Hardness	Use-Action	Polish Type	Striations	Orienation	Rounding
MW	560	2	4	5	2	3	4	6	1	1	2
MW	562	1	1	4	1	3	1	6	2	0	1
MW	572	1	1	5	1	1	1	6	2	0	2
MW	578	1	1	5	2	3	1	6	1	1	1
MW	580	1	4	7	2	5	4	6	1	3	1
MW	623	1	2	5	3	5	1	1	1	1	1
MW	627	1	3	8	1	5	1	6	2	0	2
MW	646	1	1	5	2	2	1	6	1	2	1
MW	648	1	3	8	3	2	3	4	1	1	1
MW	661	2	2	7	3	2	2	4	1	1	2
MW	676	1	1	8	3	3	1	2	1	2	1
MW	704	1	3	4	1	3	2	6	1	1	2
MW	724	1	3	7	2	3	1	6	2	0	1
MW	731	1	1	3	0	4	1	6	2	0	2
MW	741	1	1	7	3	5	1	1	1	1	2
MW	751	1	1	2	1	5	1	6	0	0	2
MW	797	1	1	5	1	5	1	6	1	3	2
MW	798	1	1	5	1	1	1	6	2	0	2
MW	834	1	1	2	3	1	2	4	1	1	2
MW	845	1	2	5	3	3	1	2	1	1	2
MW	847	1	1	5	3	3	1	1	1	3	2
MW	848	1	1	5	1	5	1	6	1	1	1
MW	854	1	1	7	3	5	1	1	1	1	1
MW	859	1	1	7	1	5	1	6	0	0	1
MW	860	2	2	5	2	4	1	6	0	0	0
MW	874	1	3	5	1	1	1	6	1	2	0
MW	888	1	1	7	1	1	2	6	1	2	2

Table B.1 (Cont.): Technological and Functional Data

Component	Artifact #	Tool Type	Edge Shape	Edge Angle	Polish Stage	Hardness	Use-Action	Polish Type	Striations	Orienation	Rounding
MW	898	1	1	5	2	1	1	6	1	1	2
MW	901	2	4	8	0	6	6	6	1	2	2
MW	903	2	4	7	0	1	6	6	1	2	1
MW	919	3	2	7	1	4	6	6	1	1	2
MW	921	2	4	8	0	6	6	6	1	3	2

Vita:

Megan M. King was born in Buffalo, NY on June 10th, 1984. In 2006, she received a B. S. in Anthropology with a minor in archaeology from SUNY Buffalo State College, in New York. In fall of 2008 she entered the graduate program at the University of Tennessee, Knoxville where she received her M.A. in Anthropology during the Fall of 2011. Megan is currently pursuing her doctorate in Anthropology at the University of Tennessee, Knoxville.